RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Vol. 57 AUGUST, 1951 No. 2

Physical and Clinical Aspects of Supervoltage Rotational Therapy[1]

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TWO OF THE MORE significant trends in radiation therapy today are the utilization of x-rays produced at higher voltages and the more adequate and uniform administration of this radiation by rotational and multiportal methods. This paper will consider the physical and clinical aspects of 2-million-volt x-ray therapy combined with rotational administration, with particular reference to the treatment of tumors of the head and neck.

CHOICE OF X-RAY VOLTAGE

The trend toward higher voltages is based on the undisputed evidence that such radiation has improved qualities of penetration, freedom from scatter, and skin tolerance at the portal of entry. Our selection of 2-million-volt x-rays as the most suitable for the general therapy problem was made after conducting studies over the 1-million to 4-million-volt range (1) and was based on fundamental and practical considerations, including the following:

(1) X-rays produced at 2 million volts attain most of the desired physical properties of increased depth dose, high output intensity, uniform field illumination, and minimum beam scatter. With a 5-cm.-square field, 2-million-volt radiation gives more than twice the percentage depth dose attained with 200-kilovolt radiation at 10 cm., and three times the dose at 15 cm. depth, with far less side-scatter. These characteristics are quantitatively shown for a 5-cm.-wide beam of 2-million-volt x-rays in the isodose curve of Figure 1. Although depth dose continues to increase with voltage, this increase is accompanied by developing non-uniformity in field illumination and increasing exit dose. It is our judgment that, for the general cancer problem, involving both large- and small-field irradiation and both bone and soft-tissue tumors, the optimum radiation

[1] Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill. Dec. 10–15, 1950.

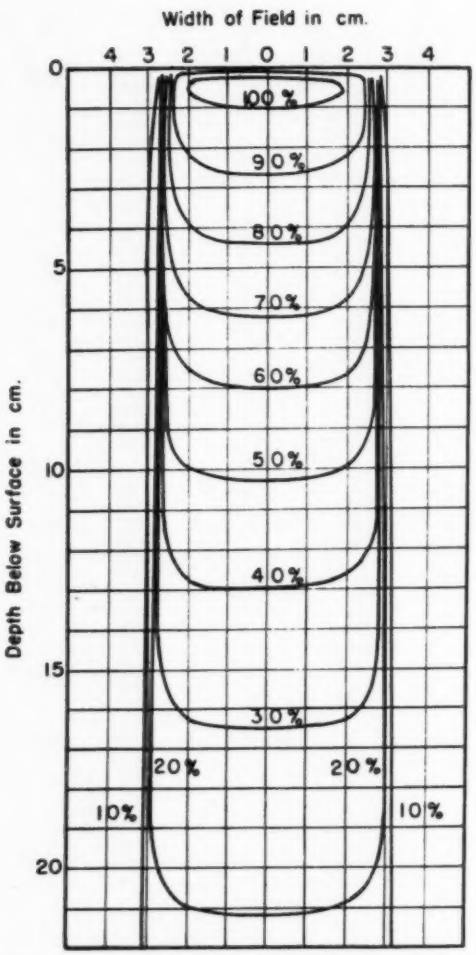


Fig. 1. Isodose curve for 2-million-volt x-rays in a 5 × 5-cm. field at 100 cm. distance and filtration of 6.8 mm. Pb equivalent.

qualities are attained broadly in the 2- to 5-million-volt range. Practical and clinical considerations, some of which are indicated below, determined our preference for 2 million volts.

(2) Skin tolerance has reached a satisfactorily high level at 2 million volts (2). About 4,000 r delivered at normal incidence in daily doses of 300 r are required to elicit a threshold erythema on the skin at the portal of entry. This skin tolerance is substantially higher than for 1-million-volt radiation; it is sufficient to render excessive skin reaction improbable, particularly under conditions of multiportal or rotational administration with careful fractionation. On the other hand, although slow increases in entrance skin tolerance are perceived at still higher voltages, the prospect of exit skin reaction increases even more rapidly.

(3) Energy is removed from 2-million-volt radiation almost entirely by the Compton absorption mechanism, a process which depends only on density. Both photoelectric absorption, which is important with x-rays of conventional voltage, and the pair-production absorption process of very high voltages depend on a high power of the atomic number. Radiation produced by conventional voltages or by many millions of volts, therefore, shows preferential absorption in bone and cartilage. That the ratio of bone to soft-tissue absorption is low at 2 million volts is shown qualitatively in the 2-million-volt roentgenogram of the head in Figure 7, in which air passages are conspicuous, but teeth, mandible, and the bony structure of the skull are relatively inconspicuous. Since most soft-tissue tumors must be approached at least in part through bone, this fundamental property of radiation in the Compton absorption region is of basic clinical importance.

(4) In choosing the most suitable voltage for general therapy, importance was attached to the obvious fact that cost, size, and complexity of direct acceleration methods increase rapidly with voltage. Either electromagnetic or electrostatic voltage sources of 2-million-volt rating are practical instruments for therapy, but the Van de Graaff electrostatic generator has ad-

vantages in its considerably smaller size, its freedom from auxiliary apparatus, and its small target spot, which facilitates the attainment of well-defined beams. This 2-million-volt x-ray therapy unit is completely contained in the treatment room; all of the radiation-producing equipment is within a steel tank 36 inches in diameter and 70 inches long. While higher voltages are entirely practical from engineering considerations (4-million-volt electrostatic accelerators are not uncommon, and a 12-million-volt unit is under construction at M.I.T.), the possible clinical benefits appear small in comparison with the substantially increased cost, size, and required protection.

(5) Two-million-volt radiation can be controlled with reasonable facility. Sharply defined fields of all sizes and shapes can readily be produced. The direct beam can be reduced to safe limits by a tolerable amount of concrete or lead, 40 inches or 7 inches, respectively. When the x-ray target is surrounded with an adequate amount of lead the supervoltage treatment room wall thickness need not be more than 12 inches of concrete.

That the quality of 2-million-volt radiation is identical with that of gamma rays of radium is a fortuitous fact of nature, not without clinical significance. Radium gamma rays have long been regarded by therapists as superior to conventional roentgen radiation, and the literature is rich in clinical observations on the greater tolerance of skin, bone, and cartilage for these more penetrating rays (3). There is no doubt that radium and its products have a permanent place in superficial and in interstitial and intracavity therapy. These radiation sources are invaluable for the treatment of relatively localized lesions and much of the knowledge of biological response of tissue to radiation has resulted from their use. The growing availability of the identical radiation in copious amounts (the beam intensity of the electrostatic 2-million-volt x-ray source being 300 r per minute at 50 cm., which corresponds to that of 5,000 gm. of radium) is to extend the usefulness of such superior radiation to larger and less accessible tumor situations and to make practical more effective technics of administration.

ROTATIONAL THERAPY

The uniform irradiation of a volume of tumor-bearing tissue with minimal energy absorption elsewhere can often be best accomplished by rotating the patient slowly about an axis through this region and accurately directing toward it a well-defined beam of suitable shape. Rotational therapy is multiportal therapy carried to its limit in a given plane. The approach to tumors from several planes of rotation is often feasible and would further improve the ratio of tumor to normal tissue dose. Particularly with 2-million-volt radiation and small fields, however, a single plane of rotation produces a remarkably high and uniformly distributed tumor dose as compared with that sustained by tissue outside the continuously irradiated region.

The attractiveness of rotational therapy has been appreciated for over forty years (4), but it has, with occasional notable exceptions, repeatedly fallen into disuse, in part because of the impracticability of irradiating deep tumors through the thicker aspects of the body. Tumors of the head and neck, however, could be approached with benefit by 200-kilovolt radiation, and Jens Nielsen of Copenhagen has done distinguished work on the rotational treatment of the esophagus. Reports on this work, however, show severe skin reaction and a considerable tissue dose in the entire skin-to-tumor region—an inevitable result of the low quality (h.v.l. 0.9 mm. Cu) of Nielsen's radiation. The availability of far more penetrating radiation removes these practical clinical limitations. With 2-million-volt radiation (h.v.l. over 12 mm. Cu), it is feasible to approach with ad-

Fig. 2. Patient positioned for treatment of pituitary by a horizontal 2-million-volt beam of circular aperture.

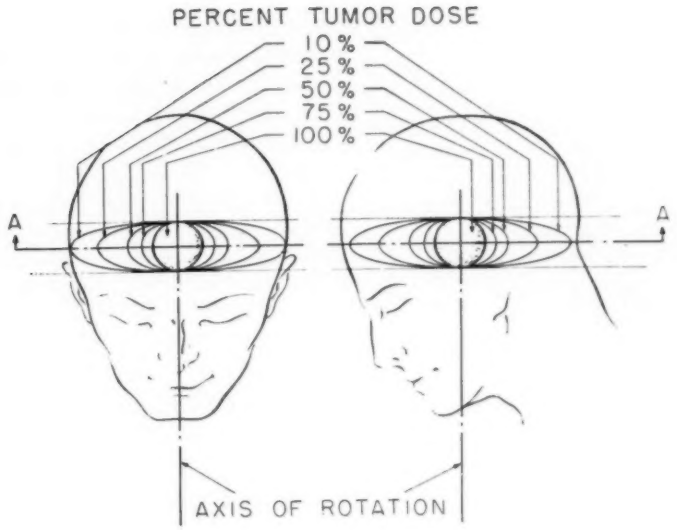
vantage deep pelvic tumors from lateral as well as anterior and posterior aspects, while accessible tumors are still more efficiently handled.

In the co-operative program of the Massachusetts Institute of Technology and the Lahey Clinic, the most generally used arrangement for rotation places the patient in a vertical position, sitting or standing, in all cases thoroughly supported by elements on the rotating stand so that precision location of the tumor axis and elevation can be determined and maintained. Tumors of the head and neck are always irradiated with the patient sitting on the rotating stand with the body firmly positioned, the head, however, being cast forward or inclined backward so that the plane of irradiation will pass through the most tolerant tissue regions. In this arrangement the 2-million-volt x-ray beam is directed horizontally toward the patient, and the elevation of the beam is controlled by raising or lowering the motorized mount of the apparatus. Coincidence is secured between the fixed axis of rotation and the axial center of the tumor region by shifting the patient in two mutually perpendicular planes. This is accomplished by making use of the two traverses which form an integral part of the rotating stand. The stand has a fixed location which gives a 125-cm. target-to-axis treatment distance, and it is essential that the x-ray beam be accurately centered upon the axis. In a few instances irradiation has been carried out with the patient in the supine position, but, while this is more feasible for non-ambulatory patients, it is otherwise somewhat more limited in its general clinical utility. The supine-patient approach to tumors of the pelvic cavity or chest might be considered for conventional-voltage therapy, since the tumor may be reached through thinner sections, but would increase the dose delivered to the radiosensitive bowel.

In either vertical or supine therapy, some arrangement for adequately securing the patient during treatment is of utmost importance. Our present rotating stand depends upon a single rigid vertical steel element with which the vertebral column of the patient is in contact, and is provided with supporting attachments at appropriate levels, such as the thigh, waist, shoulder, and head, depending upon the proximity of the treatment field. It is believed that the patient's position can be maintained within a few millimeters of its original location during the typical treatment period.

ROTATIONAL IRRADIATION OF THE PITUITARY

Figure 2 shows the patient in position for irradiation of the pituitary. The 2-million-volt x-ray beam is directed toward the tumor through a horizontal plane which passes through the frontal lobe and below the cerebellum. Pituitary adenomas of the chromophobe and chromophile types have in general been irradiated with circular fields from 3 to 5 cm. in diameter, with daily tumor doses of 240 r leading to a total tumor dose of 4,000 r. The effect of such rotational technic, as shown in Figure 3, is to irradiate continuously an essentially spherical region of a diameter



ROTATIONAL TREATMENT OF PITUITARY

Fig. 3. Sketch showing arrangement for rotational treatment of the pituitary and the isodose surfaces with a 5-cm. circular field and 2-million-volt radiation.

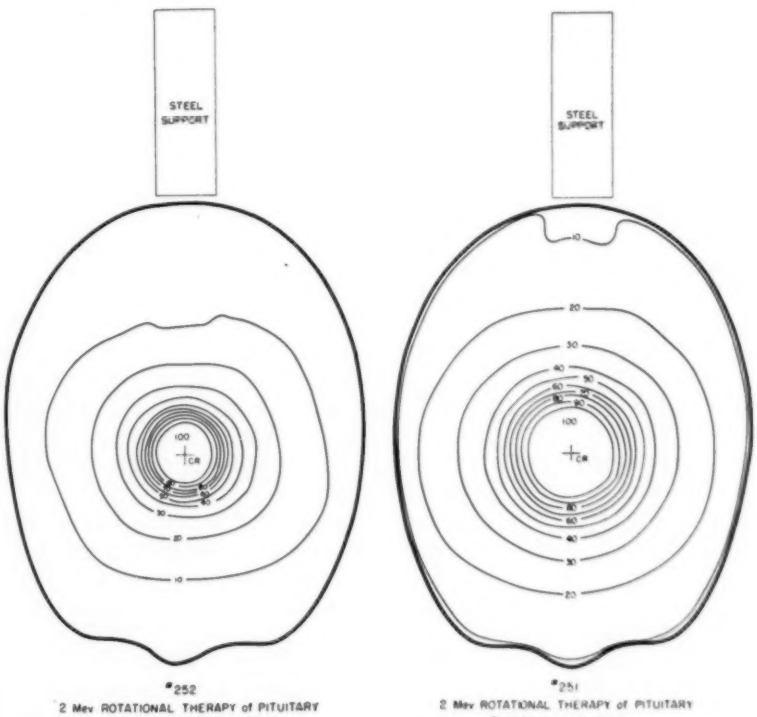


Fig. 4. Isodose charts of Plane A-A through the pituitary for 2-million-volt radiation, 3 cm. and 5 cm. circular fields, target-to-axis distance 122 cm.

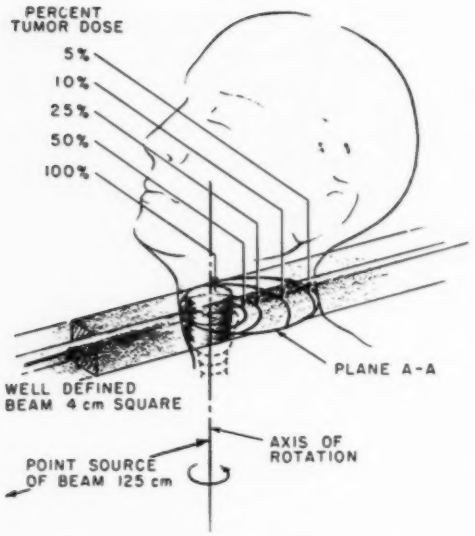


Fig. 5. Sketch showing arrangement for rotational treatment of larynx and the isodose surfaces for a 4-cm. square field and 2-million-volt radiation.

equal to that of the beam aperture. The dose outside this potentially involved region diminishes rapidly, less than 10 per cent being delivered to the skin at the lateral aspects. It is to be noted that, because of the non-scattering character of these supervoltage radiations, negligible amounts are delivered above and below the zone of rotation.

Isodose studies made with ionization chambers and by the photographic technic extensively used at Massachusetts Institute of Technology illustrate the essentially circular symmetry of the isodose lines produced by this rotational technic. Differences in the size of the patient's head and of the selected field size produce minor effects on the tumor dose at the axis of rotation, as shown in the isodose dose charts of Figure 4.

TREATMENT OF THE LARYNX

Figure 5 illustrates the method of treating tumors of the larynx by rotational therapy. In the 6 cases treated, a rectangular field, 4 × 4 cm., was centered on the involved region. The rapid diminution of dose outside the cylindrical volume continuously illuminated by this technic is shown both in the isodose lines drawn on plane A-A of Figure 5 and on the developed film of Figure 6. This film was made by sandwiching it in the neck section of a masonite phantom which reproduces the general human anatomical dimensions and x-ray absorption characteristics (5). Since a large fraction of the radiation approaches the tumor through the skin at essentially normal incidence, the high skin tolerance

Fig. 6. Film sandwiched in neck of masonite phantom and exposed to 2-million-volt radiation, as in the rotational treatment of the larynx.

of 2-million-volt radiation reduces the intensity of skin reaction even at locations nearest the tumor. No adverse reaction would be expected as far back as the spinal column and cord, where considerably less than 30 per cent of tumor dose is realized. In the cases treated so far, a total tumor dose of 6,000 r was delivered at the rate of 200 r per day.

RADIOGRAPHY WITH 2-MILLION-VOLT RAYS

In order to insure accurate alignment of the 2-million-volt x-ray beam upon the tumor-bearing region, it has become our practice to take a diagnostic picture with

the patient in position for treatment, using 2-million-volt radiation and the selected treatment field. To assist the interpretation, a second exposure made with a large field is then immediately superimposed upon this film. Such locating roentgenograms are taken both for the anteroposterior and the lateral position of the patient and serve the purpose of verifying the accuracy of positioning in all directions. Lateral double-exposure roentgenograms

Fig. 7. Lateral roentgenogram of the head made with 2-million-volt radiation with superimposed roentgenogram of rectangular treatment field for rotational therapy of nasopharynx. This technic is used to prove accuracy of positioning of patient.

made for proving the positioning in the treatment of the nasopharynx and of the larynx are illustrated in Figures 7 and 8.

It is to be noted that these roentgenograms made at 2 million volts show good delineation of air passages and relatively faint but sufficient contrast between bone and soft tissue. It has been found that air passages can often be seen more clearly than on conventional diagnostic films. In the same way, tumors of the lung stand out markedly, and their examination is quite free of the obscuring effect of the rib structure. On the other hand, barium and iodine compounds have thus far failed completely to outline the structures for which they are commonly employed. We have

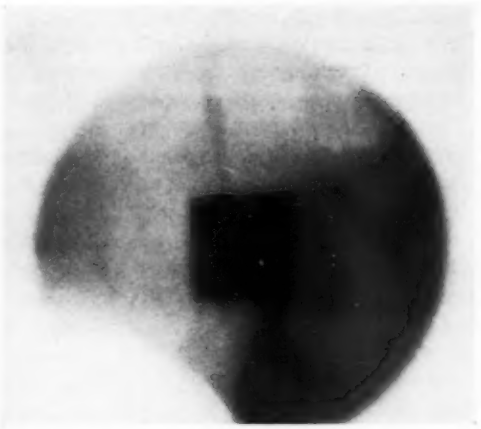


Fig. 8. Lateral roentgenogram of neck made with 2-million-volt radiation with superimposed roentgenogram of 4 × 4-cm. treatment field for rotational treatment of the larynx.

recently begun to take advantage of the good contrast between air and soft tissue obtained with 2-million-volt rays by injecting air to delineate the bladder and rectum. The gastro-intestinal tract might similarly be made discernible.

The attainment of high accuracy in the irradiation of the involved regions by radiographically proving the actual treatment fields on the patient is a tremendously important factor in the attainment of good therapy results. The radiographic qualities of 2-million-volt radiation are thus of great clinical value. External markings and other references may be used with confidence during subsequent treatments after careful positioning has been worked out and checked in the first several treatment sessions.

TOTAL BODY DOSE

In addition to the dose distribution in tumor and surrounding regions, it is desirable to be aware of the total amount of absorbed energy to which the patient is exposed during treatment. This factor, termed "total-body dose" by Mayneord (6) and expressed conveniently in gram roentgens is found by integrating the product of the exposed body tissue in grams and the x-ray dose to which it has been exposed in roentgens.

At higher total-body doses an increased effect is to be expected in blood changes and general systemic reactions, with diminished tolerance by the patient of the daily dose. The use of supervoltages, because of the greater penetration and reduced scattering, has a marked effect in reducing the total body dose sustained in the delivery of a given deep tumor dose. Rotational therapy does not in itself have the advantage of reducing the total body dose; some minor increase in total body dose may result from rotation when the tumor is approached in part through the thicker body sections. The purpose of rotation is primarily to improve the dose distribution by delivering a maximum and uniform dose to the selected tumor region and by spreading it thinly over all other traversed regions.

gram roentgens, 240 thousand of which (17 per cent) are applied to the spherical tumor region. Rotational treatment of the larynx with 6,000 r results in a total body dose of about 770 thousand gram roentgens, of which 300 thousand are in the 4 × 4-cm. cylinder centered about the tumor. Total body dose increases directly with field size, body thickness, and the delivered tumor dose. In the rotational delivery of 6,000 r to the pelvic cavity of a typical patient, with a 10-cm. circular field and 2-million-volt radiation, about 16 million gram roentgens of ionizing energy would be absorbed, of which 3.6 million would be delivered to the 10-cm. spherical volume. The total body dose would in all cases be larger if less penetrating radiation were used, and the delivered tumor dose would be less uniformly distributed.

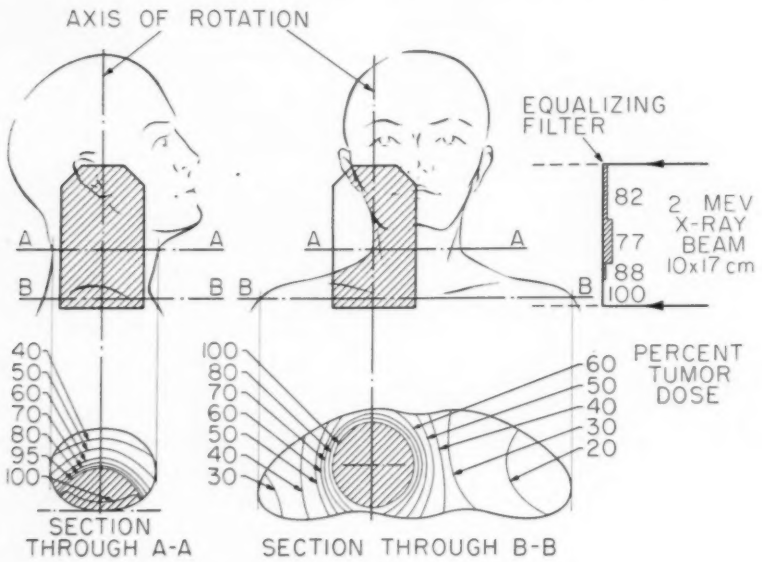


Fig. 9. Arrangement for the rotational treatment of the left tonsil with extensive neck nodes. The single 8 × 12-cm. treatment field is a vertical axis and includes the primary and potentially invaded regions. Isodose studies on horizontal planes through the neck and supraclavicular region are shown.

In the treatment of tumors of the head and neck with relatively small fields, total-body-dose reactions are rarely noted. The rotational delivery of 4,000 r to the pituitary with a 5-cm. circular field results in a total body dose of about 1,400 thousand

OTHER TUMORS OF THE HEAD AND NECK

Rotational therapy with 2 million volts has been employed in a wide variety of tumor problems in the head and neck, including tumors of the brain, nasopharynx,

and tonsil, and extensive involvement of the cervical lymph nodes. In some cases sectional rotation, rather than complete 360-degree rotation, has proved effective in avoiding radiation-sensitive regions or for producing isodose surfaces ellipsoidal in shape. In other cases, opposing lateral or anteroposterior fields offer advantages in the avoidance of radiosensitive parts. One of the largest rotational fields thus far employed in the head and neck region was 10 × 17 cm. and was used in the treatment of a squamous-cell cancer of the tonsil with extensive neck-node metastasis. In this case the vertical axis of rotation was at the side of the neck, and the base of the cylindrical treated region extended into the supraclavicular section. A study of this problem is shown in Figure 9.

CLINICAL ASPECTS OF ROTATIONAL THERAPY

Supervoltage radiation treatment using rotational and/or multiportal technic is the newest approach in the radiological treatment of malignant disease. The clinical results of this type of treatment depend on several factors: (1) the type and extent of the malignant lesion, (2) its location, (3) the ability of the tumor to respond to any type of radiation, (4) the amount of radiation given, and (5) the time interval used in its administration.

During the past fourteen months, over 150 patients suffering from malignant disease have been treated by this method. Treatment of lesions affecting all portions of the body other than the gastro-intestinal tract has been attempted, and it is hoped in time, with additional equipment, that special cases involving the stomach and colon may be treated.

It is too soon to speak of results of treatment other than in terms of palliation, and it is not our plan at this time to do more than to speak of our method of treatment, to present the primary results obtained in certain types of tumor, and to show the approach we are using in treating certain lesions involving the head and neck.

Certain factors have become apparent in using this type of treatment which are of benefit to the patient regardless of the location and extent of tumor: (1) There is less skin reaction. (2) A uniform method of administering the radiation is available, so that each part of the tumor receives the same amount of treatment each day. (3) It is possible, because of the larger fields which may be adequately treated, to include not only the tumor, but the surrounding lymphatics. (4) Rarely, with the doses as outlined below, is radiation sickness encountered.

At present our plan is to deliver 6,000 r to all malignant growths. If the lesion can be included in a port 5 cm. or less in diameter, either cylindrical or spherical, a tumor tissue dose of 240 r is given daily to complete the treatments in twenty-five treatment days, or approximately four weeks. If the lesion requires a port larger than 5 cm. in diameter, either spherical or cylindrical, the dose is reduced so that the tumor receives 170 r per day for a period of thirty-five treatment days, or approximately seven weeks, to give a total dose of 6,000 r. The two exceptions to this outline of treatment have been pituitary adenomas and thyroid carcinomas. Patients with pituitary tumors are given 4,000 r in seventeen treatment days, while those with malignant thyroid lesions receive 170 r a day until the total tumor dose of 4,800 r has been obtained over a period of twenty-eight treatment days.

Lesions of the head and neck lend themselves most readily to observation, and the complete disappearance of the tumor and its response can be determined more easily in these regions than elsewhere.

During the past fourteen months 5 patients with laryngeal carcinoma have been treated. In 4 the lesions disappeared completely, and the patients became asymptomatic. No residual radiation reaction and no aseptic necrosis of cartilage have occurred in these cases, and all have been followed for from six months to one year. The one unfavorable result was in a man of seventy-five, who had a cerebral hemorrhage the day following treatment.

Treatment of nasopharyngeal tumors has proved more complicated. In all these cases there have been cervical metastases or bone erosion in the base of the skull from extension, so that the region of the nasopharynx and the entire cervical and supraclavicular regions have required treatment. In order to treat these cases adequately, two or more ports are necessary. A cylinder large enough to cover the nasopharynx is used for one port—usually 4 cm. in diameter. The other port must be large enough to cover the area of lymphatic drainage of the nasopharyngeal region; namely, the postauricular, preauricular, cervical, and supraclavicular nodes. Of the 4 patients treated, 2 had lymphoepitheliomas and 2 epidermoid carcinomas. In 3 cases the primary tumor and lymph nodes have completely disappeared. In 1 case of epidermoid carcinoma in which, in our opinion, adequate treatment was given, the lymph-node metastases disappeared, but the primary lesion failed to heal.

Twelve patients with pituitary adenomas have been treated, in all of whom there were definite visual changes. Ten of the tumors were of the chromophobe variety, and 8 of these have shown a good response to radiation, 4,000 r being given in a period of seventeen days. In one unfavorable case it was found at postmortem examination that the lesion was not irradiated, and that it had extended posteriorly and above the field. In the other case in which the visual fields did not improve, no tumor was found at operation; either there had been no tumor to begin with, or it had been completely destroyed by the treatment.

A good response was obtained in the 2 cases of chromophile adenomas, but, since these tumors have usually been adequately managed with routine methods of irradiation, we believe that we should await a longer follow-up before they are given further consideration.

Eight patients with brain tumors, either glioblastoma or fibrillary astrocytoma, have been treated. In these cases we are attempting to use the dosage outlined by Dr. Carleton Peirce of McGill University, and again it is too early to report the results other than to say that there are less severe reactions following this method of treatment than when 200 kilovolts are used.

Among the clinical aspects requiring improvement, one of the most important is the exact and proper positioning of the patient. It is obvious that, if the lesion and the surrounding lymphatics are not included in the field, the result will be a failure. The radiographic technic of proving that we are treating the lesion has become an indispensable ally. Even with the use of very careful methods, in 2 of our earlier cases subsequent follow-up examination has shown that the radiation did not include all of the known tumor. The time-total dose relation is important and not as yet thoroughly understood, and, although our dosage rate per day may be varied in the future, we have found that patients will not tolerate a dose of 240 r per day if the port is larger than 5 cm. in diameter.

ACKNOWLEDGMENTS: The authors wish to acknowledge the contributions of the American Cancer Society in support of this work and of the Godfrey M. Hyams Trust, which has encouraged the development of the supervoltage equipment and its medical use.

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SUMARIO

Aspectos Físicos y Clínicos de la Rototerapia de Supervoltaje

La tendencia hacia el empleo de voltajes más altos en la radioterapia está basada en pruebas indiscutibles de que así mejoran las cualidades de penetración, falta de dispersión y tolerancia cutánea. A los AA. los rayos X producidos a 2 millones de voltios les han resultado los más adecuados para la terapéutica general. Utilizan una técnica rotativa, que, con campos pequeños, suministra una dosis tumor notablemente alta y uniformemente distribuída, comparada con la que reciben los tejidos fuera de la zona irradiada continuamente.

A fin de asegurar el alineamiento exacto del haz de rayos X de 2 millones de voltios sobre la zona tumorosa, se toman radiografías localizadoras, usando rayos de 2 millones de voltios, con el enfermo colocado en posición para tratamiento. Esas radiografías muestran buena delineación de las vías aéreas y contraste relativamente débil, pero suficiente, entre el hueso y el tejido blando.

Esta técnica combinada de supervoltaje y rotación ha sido usada en 150 enfermos que padecían de enfermedad maligna. Sólo se consideran aquí los tumores de la cabeza y del cuello. Aunque el tiempo transcurrido es demasiado breve para discutir los resultados del tratamiento, salvo en términos de paliación, menciónanse los siguientes. En 3 de 4 casos de tumor nasofaríngeo (2 linfoepiteliomas, 2 carcinomas epidermoideos), desaparecieron tanto el tumor primario como los ganglios linfáticos afectados. Diez de 12 tumores hipofisarios revelaron buena respuesta.

DISCUSSION

Harold W. Jacox, M.D. (New York): This has been an excellent exposition of the approach and methods used by Dr. Hare and Dr. Trump in applying multimillion-volt radiation to lesions of the head and neck. They have presented established facts and have detailed their technic without making any rash claims. I have seen their set-up and they are doing a splendid piece of work. This is really precision roentgen therapy.

For those who were unfamiliar with the term "field illumination," as I was, I think it means the distribution of radiation throughout the beam or field, or the irradiation of the tissue volume.

To be able to treat a larynx with a 4-cm. field is really an accomplishment, but these men are able to do it by holding the patient in a very firm position. I know that they showed beautiful young girls in the pictures but with an older person it is much more difficult to keep the head in that position for even five minutes.

From the physical standpoint, supervoltage is said to have less differential effect upon bony structures, but it has been shown clinically that fractures have occurred following supervoltage irradiation just as after conventional voltage therapy. This, of course, may be due more to the effects upon blood vessels than upon the osseous tissue itself.

As the authors point out, there are many incompletely understood problems in clinical radiation effects. Because of their careful and painstaking efforts and those of others in the field, significant contributions in radiation therapy will come from institutions like theirs, which are well equipped to make them.

Robert S. Stone, M.D. (San Francisco): I would like to make a few comments on the paper that Dr. Trump delivered for Dr. Hare and their associates. While I agree with much that Dr. Hare and Dr. Trump have to say, there are some points on which I disagree, and it is these that I should like to mention.

First, let us take the written statement in the Synopsis of the paper that "radiation produced at two million volts is shown to do less damage to skin and bone tissue than radiation of much higher or lower energy." I don't think very much has yet been shown as to the effects of the "much higher energy." And, so far as producing less damage is concerned, just what does that mean? You can produce just as much damage with one as with the other if you want to give enough of either to the skin. Without qualification, that statement does not hold good.

There is one other thing of which I would like to remind our physicist friends. They like—all of them—to talk about the possibility of delivering more roentgens to a tumor with one voltage than with another. Actually it matters not a bit how many roentgens you give; the important thing is what it does to the tumor. If you say

that it takes two thousand roentgens of one radiation to produce the same effect on tumor as is obtained with one thousand roentgens of another radiation, you are not saying anything different at all.

It is too bad that the same physical unit—the roentgen—is used for both the higher and the lower voltages, since they are not the same as tested on the skin, or soft tissues, or different kinds of biological materials. It takes at least 25 per cent more of your high-voltage radiation to produce the same effect.

The essayists make the statement, also, that the damage to bone is less. I don't think that is what they really mean. I think what Dr. Trump said is accurate—that the absorption of energy in the bone is probably less—and yet, going through the literature, one finds that a great many people have been worried in using high voltage because they still produced radiation osteitis. As a matter of fact, Dr. Bakke stopped using his 1,500,000-volt radiation to supraclavicular nodes because of the action on the posterior portion of the ribs.

They talk about skin sparing. Don't let this confuse you. Skin sparing and increased depth dose are the same thing. If we can get more in without damaging the skin that's fine, but we must not forget that our problem, as radiation therapists, is to get differential reaction between the tumor and the tissues around it. I think the experiences of the past have taught us that sometimes it is more dangerous to damage the epithelium inside than the skin on the outside.

I hope Dr. Trump will take these remarks in the spirit in which they are intended, i.e., as constructive and interpretive criticism.

Dr. Trump (*closing*): I appreciate very much Dr. Jacox' remarks about our effort to perform truly precision radiology and radiation therapy. This is our objective and we all have a feeling that the precision has increased during the past year but still has a considerable way to go.

In the same friendly spirit as Dr. Stone, I must say I disagree with most of the things that he said. It is true, as he says, that various people have observed that bone fractures can be produced with megavolt radiation, but this is not particularly significant. For any type of radiation there is a dose level which will produce bone fracture. I think the significant thing is that the possibility of fracture is less when the ratio of energy absorbed in bone to that absorbed by surrounding soft tissue is minimal.

Any type of radiation which is preferentially absorbed in bone ought to—and probably does—cause relatively greater damage in bone and an increased possibility of fracture as compared with radiation with a lower bone-to-soft tissue ratio. I believe that for x-rays produced in the range of a few million volts the bone-to-soft tissue absorption is at a minimum and that this will prove to be a marked clinical advantage.

Dr. Stone suggests that skin sparing and increased depth dose are the same thing. I think I understand the special sense in which this was said, but as a general remark I would not agree with it. For example, an increased depth dose was obtained with neutrons but there was no skin sparing—no skin sparing either at the portal of entry nor on underlying skin.

The skin sparing of supervoltage radiation is due to the simple physical fact that the ionization density has not yet built up to the maximum in the thin outer skin regions. The radiation damage is not produced in the skin because skin absorption does not exist to the full equilibrium extent.

Dr. Stone's statement that 25 per cent more supervoltage radiation is required to elicit a certain biological reaction in homogeneous tissue —25 per cent more than with conventional radiation—is based on obscure and uncertain evidence. Such evidence as exists is based primarily upon the lethal dose level for small animals —an index of biological effectiveness of supervoltage radiation which I would certainly disavow as significant. The factors causing the demise of a small animal are so intricate, and so likely to be different from one widely different energy region to another, that I feel that this measurement does not shed much light on the relative biological effectiveness of various radiations on homogeneous soft tissue.

It is our feeling that the effectiveness in homogeneous underlying tissue of 2-million-volt radiation and of conventional 200,000-volt x-rays are very nearly the same. Some clinicians have the feeling that supervoltage is actually more effective in such regions, but this is also unlikely. The most probable interpretation of present physical evidence is that they are of closely equal effectiveness on underlying homogeneous tissue under similar conditions of irradiation.

Value of Cross-Section Diagrams in Delivering Accurate X-Ray Therapy into the Female Pelvis[1]

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Louisville, Ky.

THE OBJECT of this paper is to revive an interest in the use of cross-section diagrams to predetermine the tumor dose. The cross section drawn at the tumor level offers the opportunity of visualizing the tumor area at its approximate depth and thus selecting adequate ports for therapy. It may be shown often that actual cross-firing of the mass will not give the best depth-dose distribution. Furthermore, the importance of determining the incident angle of the x-ray beam for each port may be seen.

The method to be described is simple, expedient, and not too time-consuming. It may be applied to any deep-seated tumor at any location. This writing, however, will confine itself to x-ray depth-dose patterns within the female pelvis.

The cross sections are made by taking caliper measurements of the anteroposterior and lateral body thickness (Fig. 1) and marking the distance in centimeters on bisecting lines on a large sheet of paper. A length of heavy lead wire is used to mold a templet at the selected body level (Figs. 2 and 3). The templet is then transferred to the sheet of paper and arranged to fit within the confines of the anteroposterior and lateral limits measured at the same level. The procedure is repeated for the other side of the body, and the completed tracing approximates the actual contour of the patient at the tumor level (Fig. 4). Physical examination and radiographs or other special examinations will indicate the tumor location, size, shape, extent or stage, and this area is carefully drawn in on the diagram. The related vital organs and bones are mapped in, using as reference any standard atlas of cross-section anatomy (Fig. 5). Because of the contour of the sacral-gluteal outline, a "Silhouette Diagram" is made with the patient in the prone position. This is accomplished by drawing vertical lines spaced at intervals to correspond to the distances from the 5th lumbar vertebra to the coccyx, and thence to the gluteal-thigh fold (Fig. 6). The height of these verticals corresponds to the body thickness at the named levels. A lead wire templet is then lifted from the mid-line of this area and arranged to fit the limits of the vertical lines and the tracing is drawn in (Fig. 7). The tip of the coccyx, cervix and uterus, and the pubes are then mapped into the diagram (Fig. 8). The Silhouette Diagram serves the purpose of measuring the angles of the x-ray beam through the sacral and gluteal ports and estimating the depth dose to the parametria.

A careful study of the two diagrams presents valuable features for depth-dose planning by furnishing an actual map of the tumor location and tumor-bearing area. Transparent isodose curves for the proper technic may be moved around over the drawings in order to select the necessary number of ports of the most adequate size and location to deliver the required tumor dose. Furthermore, the center lines from the tumor to the port center will indicate the beam angle that is necessary to irradiate the particular area. It is well to note that the contour, outline, and shape vary widely even in so-called normal or average patients. A study of the silhouette outline of two different patients will readily indicate its value for determining beam direction, particularly if the therapist is using fairly small ports in the sacral and the gluteal regions. Pressure cones may be applied to the lead wire while taking the

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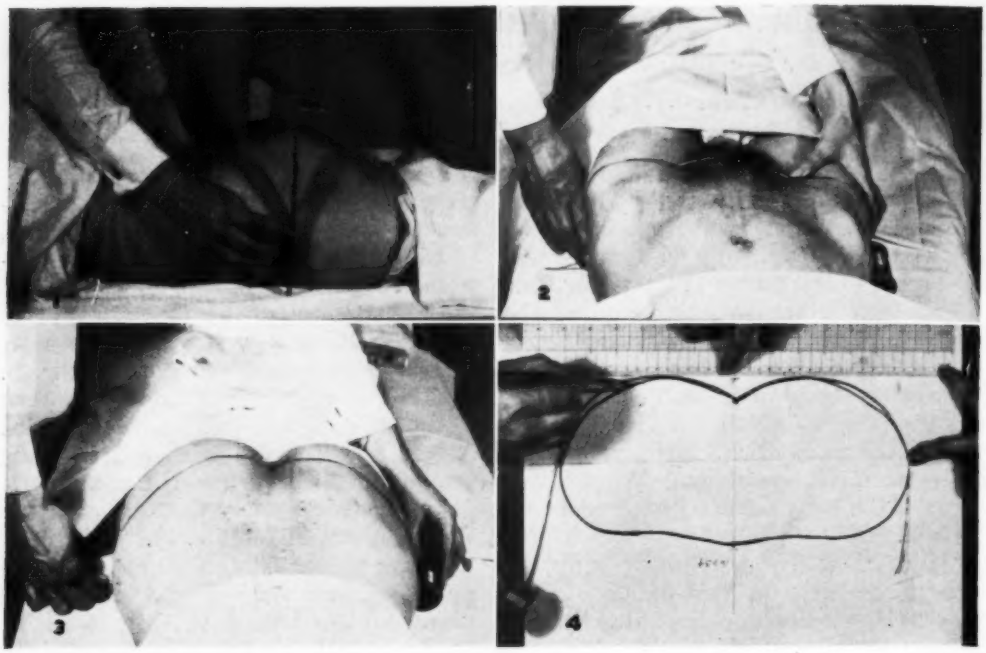

Fig. 1. Measuring anteroposterior and lateral diameters at the estimated tumor level.
Fig. 2 Molding lead wire templet to the anterior contour.
Fig. 3. Molding lead wire templet to the posterior contour.
Fig. 4. The anteroposterior and lateral diameters laid out on a large sheet of paper and the templets arranged to fit within the limits and contour traced in.

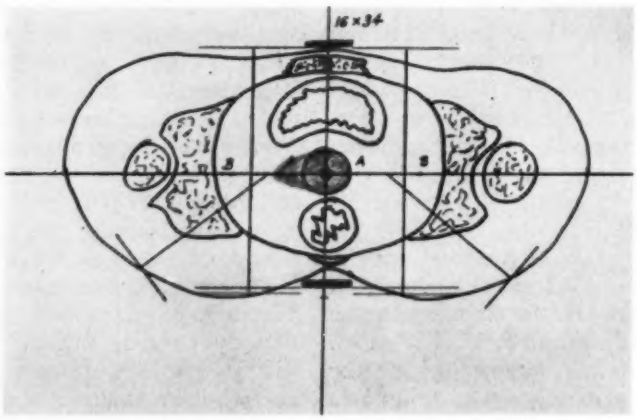

Fig. 5. The estimated tumor area marked in and related organs indicated. Transparent isodose curves indicate depth dose, beam angle, and site of ports.

templet in order to reproduce the pressure indentation in the latter. The cone should be applied at the correct predetermined angle. The diagram is completed in the usual fashion.

A simple angle indicator on the tube head is used to direct the x-ray beam angle. The one constructed by the author consists of a 4-inch circle turned into 3/4 inch plexiglass and marked off into degrees throughout

half of its periphery. Thin (1/8 inch) plexiglass forms the sidewalls and there is a free-falling ball-bearing inside. The indicator is affixed to the side of the light box of the visual localizer (Fig. 9).

This cross-section diagram method can be carried out efficiently by two people. The usual time required is one and a half man hours. It is believed that any radiologist who accepts a patient for therapy should spend enough time on the history, examination, and dose planning to develop a logical and comprehensive plan for the conduct and management of the therapy schedule. Cross-section diagram planning offers an excellent opportunity for individualizing the treatment of each patient. Then, too, the diagrams filed with the patient's chart offer detailed information for future reference.

After the diagrams are completed and isodose curves applied and summarized, the angles of the central beam from each port to the tumor or depth area are recorded on the treatment chart. Also, the general location of each port is indicated on master diagrams printed on the therapy chart, with an arrow sign pointing in the head or foot direction associated with that individual port. The ports are identified by numbers on the master diagram, and each has a separate column for daily recordings of the skin dose. The actual locations of the ports are drawn on the patient's skin to full measurement, and are remarked from day to day as the ink fades. The

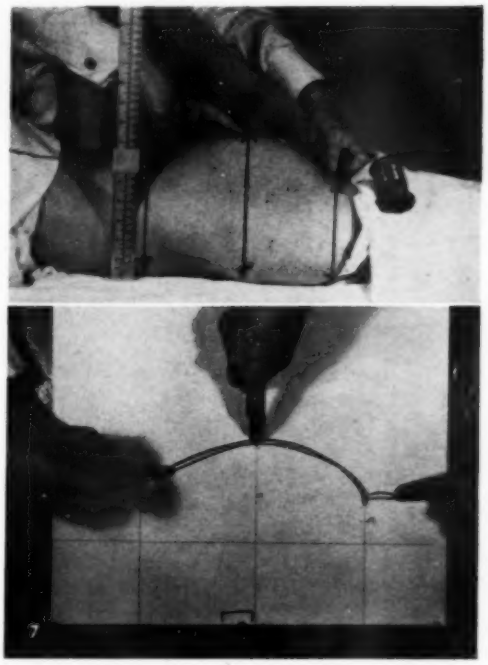

Fig. 6. Silhouette diagram with vertical lines corresponding to the distances from the 5th lumbar vertebra to the coccyx and thigh. The contour templets are arranged to fit the limits represented by these lines.
Fig. 7. Tracing in the contour.

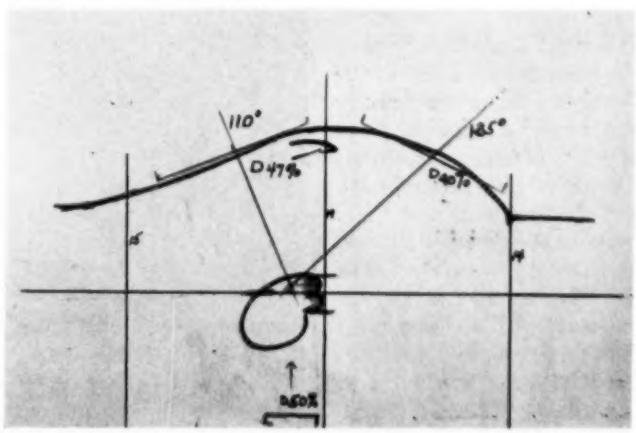

Fig. 8. Tumor area indicated. Isodose curves for depth dose and angle estimations. The silhouette contour varies enough to warrant this special diagram.

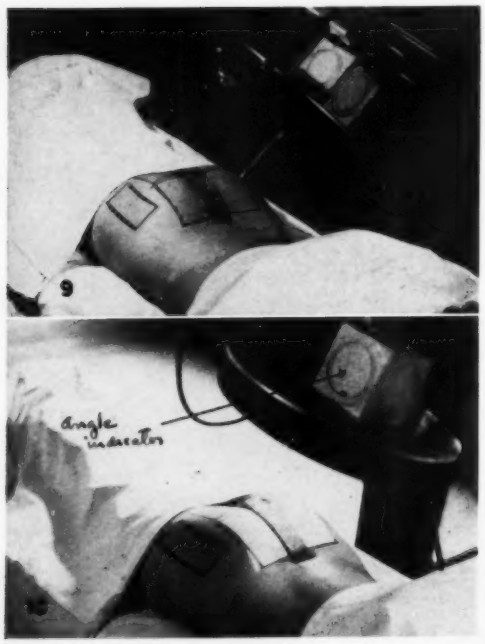

Fig. 9. Patient in treatment position. Ports marked on the skin.
Fig. 10. Angle indicator set in accordance with data from diagrams. Photo illustrates "split" port (pressure cones are advocated).

skin markings are made with the patient relaxed in the correct treatment position (Figs. 9 and 10), since a change in position or muscle relaxation after marking the skin may influence the x-ray beam angulation considerably, particularly if small ports are used.

There has been a great deal of discussion as to the value of cross sections for accurate depth distribution. In order to study the patterns of the x-ray beams at various depths within the pelvis of a female patient, a wax model of a female bony pelvis in the correct anatomical position was cast (Fig. 11). The mold for the casting was lifted from a patient, and a bony pelvis was selected of suitable size and placed anatomically in the model. The wax model was sectioned through the mid anteroposterior (sagittal) plane, and the "cervix" area marked with a small metal washer. Various "perimetrial" areas, points A and B, and the pelvic wall can be marked for identity. In order to demonstrate the value of the diagrams, photographic films (Ad-Lux) were placed between the halves of the model and exposed through simulated ports (Fig. 12).

Cross-section and silhouette diagrams were made of the wax model, and two anterior and four posterior ports were chosen with the idea of delivering a predetermined dose into the perimetrial areas without overtreating the "cervix" and the hip joint. A survey of the two diagrams indicated that a different angulation was necessary for the sacral than for the gluteal ports, while the anterior ports required 90 degrees. Furthermore, the depth dose read from the isodose curves was summarized and re-

Fig. 11. Wax model used for experiment.
Fig. 12. The wax model has been diagrammed and photographic film has been inserted in the mid-plane to record the depth distribution from multiple small ports.

corded. The model was placed in the correct therapy positions and each port was exposed to 100 r "skin dose" (including estimated back-scatter). Each port was relatively small, 6 × 10 cm., and a lead strip was used to protect the mid-line overshadowing the "cervix." There was no unusual attempt at precise positioning. The 3 × 12-cm. lead strip split a 15 × 10-cm. field, allowing the required 6 × 10-cm. ports to fall to each side. Roentgenograms (Ad-Lux film) showed surprising compositing of the three cross-firing beams to each side of the "cervix" from point "A" to the pelvic wall and apparent protection to the cervix and the acetabulum (Figs. 13 and 14).

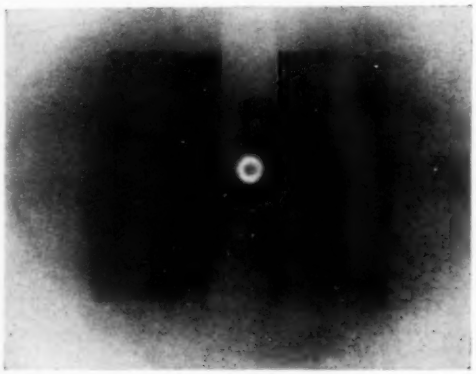

Fig. 13. Shadow patterns from 2 anterior and 6 posterior ports, 6 × 10 cm. Accurate overlaying of shadows due to angles obtained from diagram of wax model.

For added interest densitometer readings taken at selected points along the perimetrial line compared to a curve constructed from densities of known control films indicated that the estimated depth dose derived from isodose curves compared favorably with the dose interpreted from the densitometer readings. The specific use of the film was only to show the depth patterns at simulated points A and B, as well as at the cervix within the female pelvis. Since the wax model was of a patient, it may well be assumed that this distribution takes place within a pelvis and that it may be controlled and may be definitely achieved by employment of a method such as cross-sectional diagrams as a guide and observing the required angle of attack. For comparison, the conventional 2 anterior and 2 posterior ports, 10 × 12 cm., were exposed in the wax model. The film indicated overlap at the cervix, and the photographic patterns extended well beyond the hip joints.

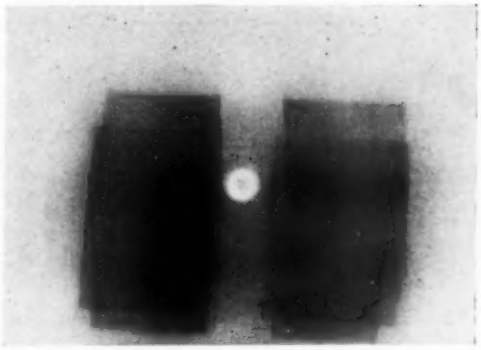

Fig. 14. Shadows from 2 anterior and 4 posterior ports.

In order to demonstrate the accurate control that may be gained by the diagrams, a point was selected on the cross-sectional drawing of the model which is ordinarily beyond point B at the pelvic wall. This point was then located in the model and marked with a small metal object. The angles from three widely separated anterior ports and one unopposed posterior port were recorded. These ports were marked on the surface of the model, each being 5 × 5 cm. A film was placed in the mid plane and exposed through the four ports. The developed film showed fairly even cross-firing, and the four patterns could be identified falling around the central shadow of the marker (Fig. 15).

A second model of solid wax was cast from the original mold and sectioned through the sagittal (mid anteroposterior) plane, then cross-sectioned through the level of the pubes, and then bisected through the mid thigh-obturator sacral plane. Thus it would be possible to visualize the cross-firing pattern at the perimetrial level on one side of the model's pelvic area, and also to show a photographic study of the three x-ray beams merging

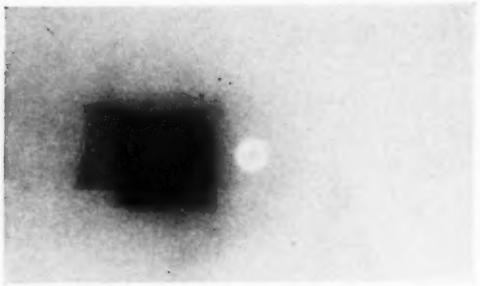

Fig. 15. Pattern from 2 anterior and 2 posterior 5 × 5-cm. ports, cross-firing "node" at pelvic wall.

at perimetrial level on the other side of the pelvis. Films were inserted into these three planes and, with small divided or split ports, two anterior, two sacral, and two gluteal fields were exposed, 100 r (including estimated back-scatter) being delivered to each port. The developed films, reassembled according to the original planes, formed a visual or photographic isodose recording of the overlapping beams. Densitometer readings of this complexity formed a none too accurate but interesting summation curve picture of the isodose distribution.

Although the densitometer readings were not taken too seriously, the data were impressive enough to suggest that a predetermined depth dose could be delivered to any given point within the pelvis. Erratic density readings were encountered in the control films for various depth levels in spite of identical numbers of roentgens delivered, monitored by an ionization chamber. This phenomenon was thought to be due to the film not being wave-length independent. It was first believed that the film might be calibrated and used to determine accurate depth-dose readings in the distribution patterns. Hot spots are encountered in the most surprising places, and these areas of over-irradiation can often be avoided by careful depth-dose planning with transparent isodose curves maneuvered over the diagrams.

SUMMARY

1. The authors believe in the value of using some visual method of tumor dose planning. They believe that a diagram method and the use of carefully chosen ports with control of the angle of the x-ray beam will avoid unnecessary widespread radiation in the body and will yield better depth distribution.

2. The method described, which is neither new nor original, employs simply drawn cross-sections and silhouette diagrams interspaced with only the tumor areas and the necessary landmarks. With the aid of transparent isodose curves of the correct half-value layer, the depth dose and incident x-ray beam angle are determined for the desirable number and location of the ports. An angle indicator is used on the tube head in order to direct the x-ray beam at the predetermined angle.

3. This method is used in the authors' practice and has proved to be neither burdensome nor time-consuming.

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SUMARIO

El Valor de los Diagramas en Corte Transversal para la Roentgenoterapia Exacta en la Pelvis Femenina

Recomiéndase el empleo de un método diagramático como medio de predeterminar la dosis tumor para las neoplasias profundas, de seleccionar puertas apropiadas y de determinar el ángulo de incidencia del haz de rayos X para cada puerta. En esta forma es posible obtener mejor distribución profunda y evitar la innecesaria dispersión de la radiación por el cuerpo. Aunque el procedimiento es aplicable a cualquier tumor profundo, el trabajo actual sólo reza con las neoplasias de la pelvis femenina.

El método descrito, que no es ni nuevo ni original, emplea cortes transversales y diagramas en silueta interespaciados, sencillamente trazados, con sólo las zonas tumorosas y los puntos de referencia. Con la ayuda de curvas transparentes de isodosis de la correcta capa de hemirreducción, se determinan la dosis a profundidad y el ángulo de incidencia del haz de rayos X para el número conveniente de puertas situadas adecuadamente. A fin de asestar el haz de rayos X al ángulo predeterminado, se usa un indica-ángulos en la cabeza del tubo. Este método no ha resultado ni oneroso ni prolijo.

(*For Discussion, see following page.*)

DISCUSSION

William L. Palazzo, M.D. (Teaneck, N.J.): Dr. Love has presented a simple and easily executed method for use in planning accurate therapy in the female pelvis. The external contour of the pelvis is easily determined by this method. However, it is not so simple to ascertain accurately the position of the tumor and the extent of its spread.

A roentgenogram with a recognizable metallic object placed in the cervical os will help in the localization of the uterus. It will also be recalled that the position of the uterus may vary significantly, depending upon whether the patient is in the prone or supine position.

I have seen the excellent bibliography which accompanies Dr. Love's paper and it indicates that there has been a great deal of discussion in the literature concerning the planning and the execution of deep therapy. Dr. Love has himself made an excellent contribution to the subject, and I am sure that many of his ideas will be adopted.

Primary Malignant Epithelial Tumors of the Small Bowel[1]

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PRIMARY MALIGNANT tumors of the small intestine are admittedly rare but the recognized incidence is increasing, due largely to improved diagnostic facilities and a renewed interest, during the last decade, in small bowel studies. Accurate clinical recognition of small bowel disturbance in day-by-day practice is still uncommon (14), and only 25 per cent of the tumors are definitely diagnosed on roentgen examination (2), though no other procedure approaches this in accuracy.

INCIDENCE

In a review of material in the Department of Surgical Pathology at the Presbyterian Hospital, New York City, Swenson, in 1943, found 9 carcinomas of the jejunum and 5 of the ileum (13). The absence of carcinoma of the duodenum in his study is noticeable. The records of the University Hospitals of Cleveland, from 1933 to 1946, show 14 cases of primary carcinoma of the small bowel, *i.e.*, about one case to 3,000 admissions on the surgical service or to 9,000 general hospital admissions (10).

According to Ewing (12), only 3 per cent of all malignant tumors in the gastrointestinal tract occur in the small bowel. At the Cook County Hospital, Chicago, 7 cases of carcinoma of the small bowel (3 duodenal and 4 jejunal) were found in 10,309 necropsies, while comparative records showed 273 carcinomas of the stomach and 163 involving the colon (5).

Males are more commonly affected than females, in a ratio of 2 or 3 to 1. Dixon (8) and others found the incidence of duodenal tumors to be highest between fifty and seventy years of age. Bockus (1) reports that small bowel tumors generally occur in patients about ten years younger than this.

Various theories are propounded to account for the relative infrequency of carcinoma of the small bowel. These include the lack of abrupt angulations in this part of the intestinal tract, the fluid character of the contents, absence of stasis, the alkalinity of the contents, the effect of the secretions, and the absence of sudden changes in the type of epithelium such as occur elsewhere in the gastro-intestinal canal (4, 5).

PATHOLOGY

The primary malignant lesions in the duodenum are of the carcinomatous type, while those in the jejunum and ileum include carcinoma, carcinoid, and malignant melanoma. Dixon (8) and others report approximately equal distribution of the lesions in the first, second, and third portions of the duodenum, though most observers have found the third portion to be involved less frequently than the proximal portion (9, 12, 17). The duodenal lesions are usually infiltrating and constricting, although occasionally a fungating tumor is found in the second portion. There is definite evidence that a chronic ulcer of the first portion of the duodenum may be a precursor of carcinoma (12). In these cases the type of neoplasm is very similar to carcinoma of the stomach.

Carcinoma of the jejunum and ileum may be polypoid, ulcerative, sclerosing, or annular, or may combine two or more of these features. It is found most frequently within about 20 inches distal to the ligament of Treitz. The remainder of the jejunum is usually spared (15). The ileum is less frequently involved by adenocarcinoma than the proximal jejunum.

The distal portion of the small bowel is the most common site for carcinoid. This

[1] Presented before the Texas State Medical Association, June 1950. Accepted for publication in January 1951.

tumor invades the bowel locally and may be multiple; it produces a defect in the lumen and metastasizes late (3, 12).

Only a few cases of primary malignant melanoma of the small bowel have been reported (6, 7, 11, 16, 18).

SYMPTOMATOLOGY

When the proximal small bowel is the site of a malignant tumor, vomiting is a much more prominent feature than with lesions in the lower small bowel. The signs and symptoms are usually insidious in onset. There may be a history of discomfort rather than actual pain, lasting for months. A lesion in the jejunum frequently manifests itself chiefly by a reflex pylorospasm. "Waves of nausea" may occur rather than a constant complaint. Symptoms may be related to the intake of food, but the relationship may go unrecognized by the patient because of an interval of several hours between their occurrence and mealtime. Doub (9) points out that right upper quadrant pain is the most constant symptom in tumors of the duodenum.

PHYSICAL EXAMINATION

Weight loss is a common observation. The most significant physical findings are limited to the upper abdomen, the signs being generally those of incomplete obstruction. When marked distention exists, the lesion is well advanced. Localized tenderness and a mass which moves under the examining hand are significant findings. A mobile mass is more likely to be present in the lower small bowel. Most patients have blood in the stools; some have large tarry stools. With a carcinoid lesion there is usually no blood in the stool. Anemia is of frequent occurrence, due to blood loss and the toxic effect of the neoplasm. In one of the cases to be reported here, the signs and symptoms were so misleading that a group of clinicians carefully investigated the kidneys but overlooked the lesion in the jejunum.

DIAGNOSIS

The usual roentgen-ray examination of the stomach followed by a film at five or six hours is not adequate for the detection of lesions in the lower small intestine, though lesions of the duodenum should be discovered if the examiner is aware of their probability. It is considered the responsibility of the clinician to request a small bowel study when it is indicated, but the author has made it a routine procedure to ask a few questions during the stomach examination. If the gastric findings do not suffice to explain the complaints, interval films are made of the whole abdomen at about thirty minutes, one hour, and two and one half hours, followed by the usual six-hour film. This serves as a screening process and frequently gives diagnostic information. If any question remains, a small bowel study is requested. Fluoroscopy during the progress of the barium through the small bowel is important, though time-consuming. Films should always be made in conjunction with the fluoroscopic study in order to determine the constancy of any variations observed.

It is usually not difficult to demonstrate an obstructive lesion if the examination is made for that purpose. The small defect in the lumen is less easily determined, but such lesions are most successfully treated. Golden (13) states that there is no danger in giving barium orally in the presence of small intestinal obstruction, since the bowel contents remain fluid and can be aspirated if necessary.

The use of the Miller-Abbott tube has greatly improved the accuracy of diagnosis of small bowel lesions. Intubation of the bowel permits one to inject the barium at the exact site of the suspected involvement. If necessary, the opaque material can be aspirated. This method often permits a differential diagnosis which might otherwise be impossible. It appears to be of greatest value in early lesions but was not used in any of the cases to be reported here. If a patient is not examined until perforation or intussusception (19) has occurred, the clinical picture is not that of the primary condition. Weintraub and Williams (20) have published a preliminary report on the use of cold normal saline with bar-

ium for the examination of the small bowel. The efficiency and simplicity of this method would appear to recommend it.

The roentgen findings depend largely upon the stage of advancement of the disease. In the cases reported below, the obstructive factor was the important one in the duodenal lesions. In the jejunal lesions the defect in the lumen was obvious in 2 cases. The polypoid or fungating neoplasms show defects in the continuity of the mucosa; carcinoid lesions usually are not ulcerated. The constricting neoplasms are about 2 to 5 cm. in length, which serves to differentiate them from inflammatory lesions, which are usually longer. Adenocarcinoma is likely to constrict the lumen, while with primary sarcoma there is dilatation at the tumor site. In the presence of obstructing neoplasms the proximal gut is dilated and thickened; frequently a "step-ladder" pattern of the mucosa is observed.

Fig. 1. Case I: Adenocarcinoma of the duodenum. Characteristic dilatation of proximal duodenum due to an annular neoplasm in the third portion, indicated by arrows.

CASE REPORTS

CASE I, Adenocarcinoma of the duodenum (Fig. 1): E. J., a 52-year-old colored housewife, was admitted to the hospital Aug. 27, 1948, complaining of abdominal cramping for about a year. For the past five days vomiting had been associated with the cramps. About January 1947, the patient had noticed blood in the stools several times.

The physical examination was essentially negative except for tenderness over the whole abdomen, more pronounced over the right lower quadrant. Blood examination revealed an extreme secondary anemia. Urinalysis was negative except for some granular casts. A serologic study of the blood was positive for syphilis. Ewald's test meal showed a small amount of blood and absence of free hydrochloric acid.

There was poor concentration of dye in the gallbladder as shown on the cholecystogram.

A barium study of the gastro-intestinal tract revealed dilatation of the proximal duodenum as a result of incomplete obstruction of the distal portion, presumably by a new growth.

On exploratory laparotomy, an inoperable tumor of the distal portion of the duodenum was found, with invasion of the pancreas. A biopsy was taken and a gastro-enterostomy performed. The *pathological diagnosis* was adenocarcinoma, Grade 4.

The patient died, Sept. 1, 1948.

Comment: It is significant that in this case there was a history of blood in the stools about nineteen months before the patient came for examination.

CASE II, Adenocarcinoma of the duodenum (Fig. 2): C. C., a 63-year-old white housewife, came to the hospital on March 21, 1948, with a six-month history of vomiting, which had become increasingly severe. The vomitus had never contained blood, and blood had not been observed in the stools. There had been a weight loss of 30 pounds in the last three months. There was no history of jaundice. A competent roentgenologist had examined the stomach two weeks before admission and reported it normal.

The physical examination was negative except for obvious undernourishment. Urinalysis was normal, and there was no anemia.

The cholecystogram showed poor dye concentration.

Roentgen examination of the gastro-intestinal tract with a barium sulfate suspension revealed an annular new growth in the third portion of the duodenum, producing incomplete obstruction.

At operation a lesion about 4 cm. in length was found partially obstructing the third portion of the duodenum. The small bowel was dissected from the pancreas and the duodenal tumor was resected. The *pathological diagnosis* was adenocarcinoma, Grade 3.

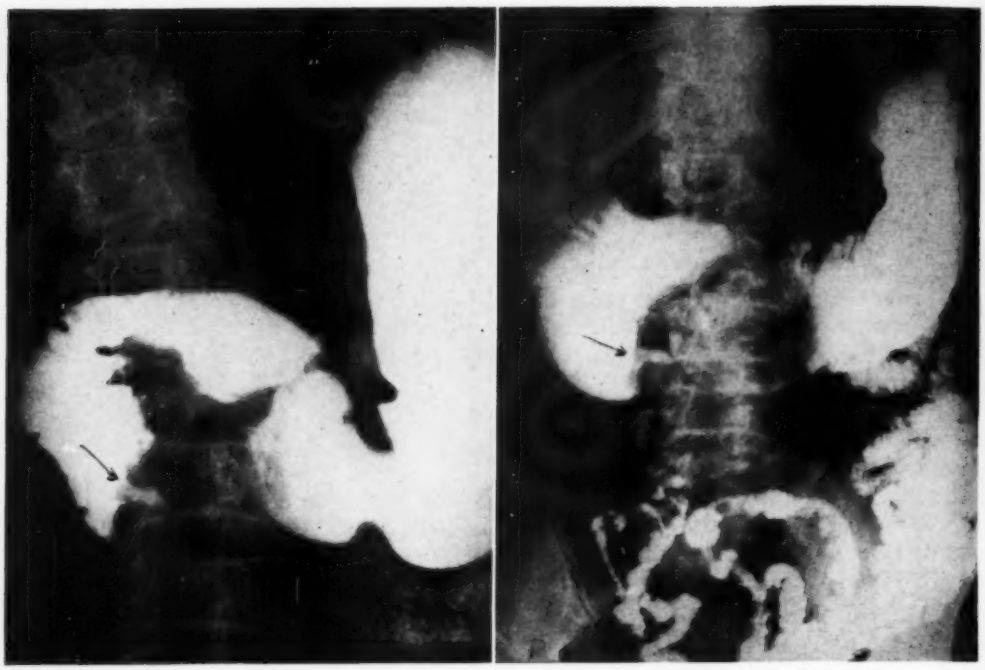

Fig. 2. Case II: Adenocarcinoma of the duodenum, producing annular constriction.

The patient died on the sixth postoperative day of cardiac failure and terminal pneumonia.

Comment: In this case vomiting was the only positive finding in the history or physical examination. The operative record contains a note by the surgeon, who has been doing a large volume of surgery for thirty years, that he had never before seen a primary carcinoma in the third portion of the duodenum.

CASE III, Adenocarcinoma of the jejunum (Fig. 3): R. J., a 48-year-old housewife, was first admitted to the clinic on Feb. 19, 1935, complaining of severe pain in the left abdomen, radiating to the left back and hip, with associated upper abdominal gas, nausea, and vomiting. Recently the attacks of pain had required narcotics for relief. There were no bowel irregularities and no urinary complaints. A retrograde pyelogram was normal. An appendectomy was done, as well as a subtotal hysterectomy, and a cholecystectomy for cholelithiasis.

The patient returned to the clinic on Sept. 28, 1943, again complaining of pain in the left abdomen extending to the left back. She had some indigestion and nausea, painful frequent urination, and marked anemia. There had been a 20-pound weight loss

Fig. 3. Case III: Adenocarcinoma of the jejunum. Defect in the jejunum indicated by arrows.

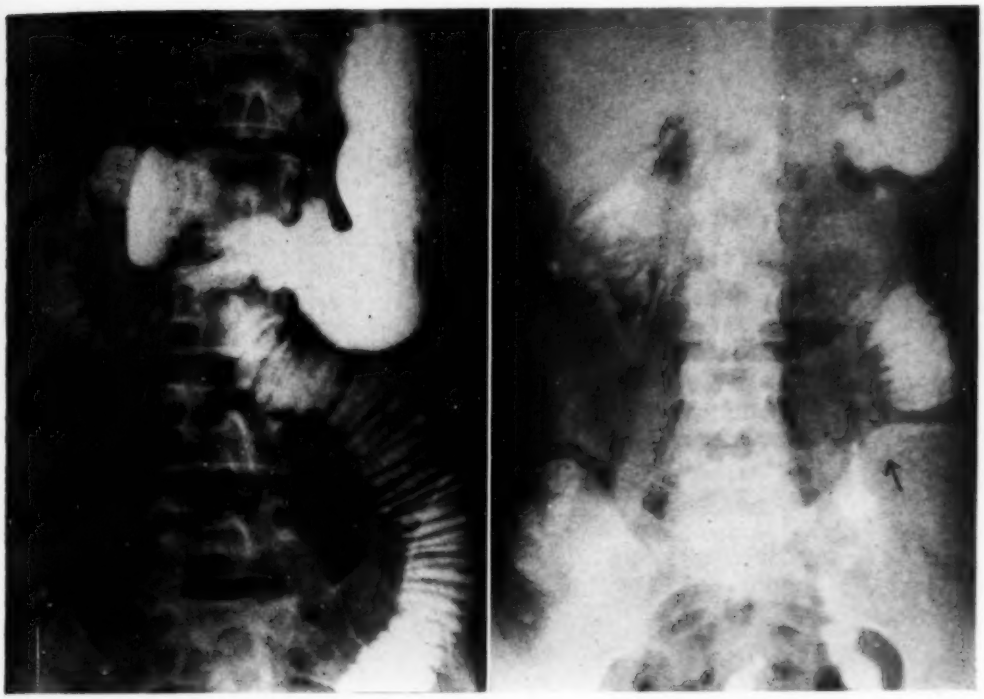

Fig. 4. Case IV: Adenocarcinoma of the jejunum. Films showing irregularity of the bowel lumen and characteristic step-ladder pattern of small bowel obstruction.

in the past year. A complete examination was refused.

On Oct. 20, 1943, the patient complained of epigastric pain but still refused a roentgen examination. In November her anemia was definitely improved. On Feb. 12, 1944, she was moderately anemic. Ewald's test meal was normal. Roentgen examination of the stomach on that date and again on March 2, 1944, was reported normal. The patient complained of more left upper abdominal pain. Clinically, she was suspected to have pancreatic disease, but this was never established.

Examination in another clinic, on July 20, 1944, led to the following diagnoses: (1) retroperitoneal tumor, in the left kidney region, (2) hypochromic anemia, (3) vitamin deficiency.

At operation a large ulcerative mass was found involving the jejunum, about 8 to 10 inches distal to the ligament of Treitz, extending by continuity to the mesentery of the colon and invading the transverse colon. A block resection was performed, removing about 10 inches of the transverse colon and about 12 inches of the jejunum. The *pathologic diagnosis* was adenocarcinoma of the jejunum.

When the patient was seen on March 4, 1945, the clinical impression was that liver metastasis had occurred.

Comment: There is an interesting similarity, in this instance, of the presenting symptoms at the time of operation and the symptoms complained of about nine years earlier. One must conjecture whether some lesion, possibly a polyp, might originally have been present in the jejunum.

CASE IV, Adenocarcinoma of the jejunum (Fig. 4): M. B., a 62-year-old white housewife, was admitted to the hospital on Oct. 8, 1945, complaining of gaseous distention of the abdomen and vomiting. These complaints were of about seven weeks duration. The patient had been in another hospital for thirty-six days.

The past history was non-contributory except for examination in a large clinic a few months before admission, when no abdominal lesion was found.

The physical examination was negative except for moderate upper abdominal distention and a small palpable mass in the left upper abdomen after the bowel was deflated. Clinical laboratory examinations of the blood and urine were negative relative to the condition under discussion.

The films of this case were brought to the author in consultation, and the impression was gathered

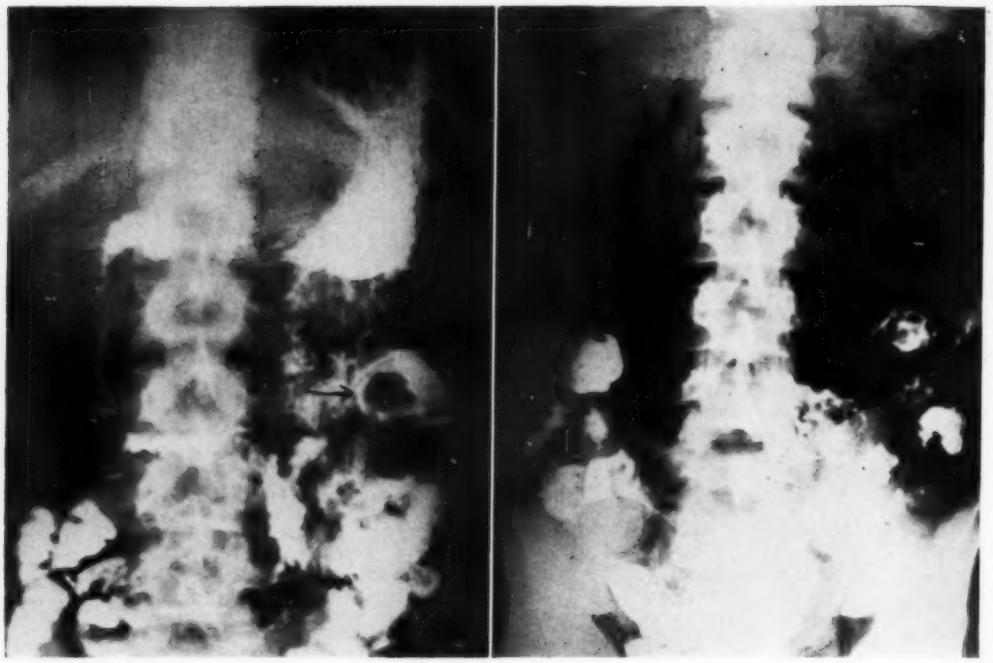

Fig. 5. Case V: Multiple melanoma of the jejunum. Films showing irregularity of bowel lumen and abnormal retention of barium in the tumor area.

that the obvious obstruction of the jejunum was most likely due to a new growth.

The patient was operated upon on Oct. 17, 1945. An obstructive tumor was found about 18 inches distal to the ligament of Treitz, but no enlarged lymph nodes were seen in this area. The gut proximal to the tumor was indurated and dilated. The tumor was resected. The *pathologic diagnosis* was annular obstructing papillary adenocarcinoma of the jejunum, Grade 2.

Recovery was uneventful, and the last report, Nov. 30, 1945, was that the patient's condition was entirely satisfactory.

Comment: This case is to remind us that neoplasms of the small bowel, although relatively rare, must be considered. This patient had been hospitalized in two different institutions, and apparently this type of lesion was not considered.

CASE V, Multiple melanoma of the jejunum (Fig. 5): O. A., a 28-year-old white engineer, was admitted to the clinic on May 14, 1942, complaining of bloating, soreness in the left abdomen, weakness, weight loss of 30 pounds, and nausea and vomiting. These symptoms had appeared about five months before admission. There were no irregularities of the bowels and no bloody stools. The past history was non-contributory.

Physical examination revealed slight rigidity with tenderness over the left upper quadrant. There was no enlargement of the liver or spleen and no adenopathy. Examinations of the blood and urine were normal. The stool examination showed a small amount of blood. Ewald's test meal showed absence of acid. The blood Wassermann reaction was negative.

Roentgen studies of the chest and gallbladder were negative. A barium study of the gastro-intestinal tract showed a filling defect in the jejunum, which was interpreted as a tumor without obstruction. An intravenous pyelogram was negative.

At operation, May 19, 1942, a large amount of the jejunum was removed. The tissue was obviously malignant, and the surgeon thought that it was probably lymphosarcoma. Careful examination revealed no nodules in the liver or other abdominal organs. The *pathologic diagnosis* was malignant melanoma. The full pathological description is as follows:

"The specimen submitted consists of 88 cm. of jejunum and attached mesentery, which is indurated. The lumen of the intestine is practically obstructed at three points. Nine centimeters from the upper extremity is the first obstruction, which is

produced by a pedunculated, egg-shaped, mottled, firm tumor that measures 10 cm. in length by 6 cm. in its greatest diameter. The mucous membrane is pinkish-gray, except that covering the tip; this portion is hemorrhagic. The pedicle of the tumor is 3 cm. in diameter. At this point it involves the entire thickness of the wall, producing an umbilicated, firm, gray area on the serosa that measures 2 by 1 cm.

"Fifteen centimeters below the base of this tumor there is a volvulus produced by a very large, ulcerated tumor mass that has invaded the attached mesentery to its base. The mass forms elevated, smooth, gray to yellow tumors on the serosal surface of the intestine and in the mesentery. This tumor involves an area 10 by 7 cm. and is 5 cm. in its greatest thickness. The tumor is woody, friable, and breaks in longitudinal bands.

"Approximately 2 cm. below this large tumor, there is a smaller circular lesion, 3 cm. in diameter, that has also ulcerated and produced a firm tumor on the serosal surface.

"Fifteen cm. below this small tumor is the third obstruction, which is produced by a flat, pedunculated tumor that measures 5 by 5 by 3 cm. The serosa covering this nodule is also smooth, glistening, and elevated over a friable tumor. The cut surfaces of this tumor show more pigmentation than the cut surfaces of the other tumors. It is friable and also breaks in longitudinal bands. Approximately 30 cm. below this obstruction there is a circular, ulcerated tumor 3 cm. in its greatest diameter, which produces a nodular, smooth, glistening tumor on the serosa. The mucous membrane surfaces of all tumors are remarkably smooth. The mucous membrane is hyperemic and shows no ulcerations except that covering the tumors. The mesentery contains a number of small, firm, yellowish-gray lymph nodes.

"Histological sections from the tumors of the jejunum consist of interlacing bundles of anaplastic cells and fine strands of adult connective tissue. There is a predominance of spindle cells in sections from the pedunculated tumors and polyhedral cells in sections from the flat, ulcerated lesions. Near the base of these tumors the cells occur in small nests and columns with an alveolar arrangement supported by fine strands of connective tissue. The majority of the tumor cells have large, hyperchromatic nuclei, mostly single, which lie in the central zone of granular cytoplasm. Some of these have large, slightly eosin-stained nucleoli. There are a number of cells with large, irregular mitotic figures, and in the more fibrous areas a very occasional small multinucleated cell. There are also large cells with vacuolated cytoplasm and large, centrally placed, deeply stained nuclei. In sections from all tumors there are a few cells that contain brown pigment. These pigmented cells are most numerous in sections from the more fibrous pedunculated tumors. The longitudinal muscle fibers have been replaced by the tumor cells, and the adjacent circular layer of muscles at some points is atrophied. Sections from many of the small yellow lymph nodes are inflammatory."

Fig. 6. Case VI: Adenocarcinoma of the ileum. Film obtained after oral administration of barium. In retrospect an irregularity in the mucosal pattern of the ileum is evident, indicated by arrows.

Chest metastasis developed and death occurred on Nov. 11, 1943.

CASE VI, Adenocarcinoma of the ileum (Fig. 6): G. K., a 41-year-old white farmer, was first admitted to the clinic on April 1, 1948, complaining of pain in the upper right abdomen, loose foamy stools, loss of weight, and weakness. He had first noticed the pain while riding a grain combine over rough ground, about six months before admission. The stools had been loose for the last seven weeks. There had been as many as ten bowel evacuations in twenty-four hours, but blood had never been noticed in the stools.

The examining physician recorded the following positive physical findings: obvious weight loss, temperature 99° F., moderate distention of abdomen, hyperperistalsis, tenderness in right upper quadrant, and external hemorrhoids.

The blood findings and urinalysis were normal. Several examinations of the stool showed no blood. The serologic test for syphilis was negative. Ewald's test meal showed slight elevation of hydrochloric acid.

Roentgen examination of the gallbladder, with

priodax, showed poor concentration of the dye. Examination of the gastro-intestinal tract with barium was reported negative.

The patient was kept under observation, and repeated blood examinations showed a mild leukocytosis. On April 16, 1948, he reported that the diarrhea had improved but became worse while he was riding a tractor. The clinical impression was acute appendicitis and possibly cholecystitis.

Operation, April 20, 1948, revealed a nodular ulcerative mass involving two loops of terminal ileum. There had been a perforation, which was covered with omentum. The mass was 3 to 4 inches in diameter and was resected. There were numerous enlarged lymph nodes in the area.

The pathologic diagnosis was ulcerative inflammatory adenocarcinoma, Grade 3, with involvement of regional lymph nodes.

A series of deep x-ray therapy was given to the tumor area, and when the patient was last seen, Feb. 7, 1949, there was no evidence of recurrence.

Comment: Upon examination, the right lower quadrant was too tender to permit palpation of the loops of the ileum. The entire course of the disease was that of an inflammatory process, but an inflammatory carcinoma was not suspected. It is noteworthy that repeated examinations revealed no blood in the stool.

SUMMARY

Primary cancer of the small bowel is relatively rare. It accounts for about 3 per cent of the malignant lesions of the gastro-intestinal tract.

The types of primary epithelial malignant lesions in the small intestine are carcinoma, carcinoid, and melanoma.

Blood in the stool is a fairly constant finding in case of carcinoma but not in carcinoid. The history is significant but the physical findings are not reliable, except in advanced cases.

A thorough roentgen examination is the most accurate means of diagnosis.

A screening process in the routine examination followed by special examinations of the small intestine may give better results than have been accomplished in the past decade.

Six cases of primary epithelial malignant tumors of the small intestine are reported.

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SUMARIO

Epiteliomas Malignos Primarios del Intestino Delgado

El cáncer primario del intestino delgado es relativamente raro, correspondiéndole aproximadamente 3 por ciento de las lesiones malignas del tracto gastrointestinal.

Las formas que revisten las lesiones malignas primarias del epitelio en el intestino delgado son carcinoma, carcinoide y melanoma.

La melena es un hallazgo bastante constante en los casos de carcinoma, pero no en el carcinoide. La historia es importante, pero los hallazgos físicos no son fehacientes, salvo en los casos avanzados.

El medio más exacto de diagnóstico es un detenido examen roentgenológico. El empleo de radiografías tomadas a ciertos intervalos durante el examen corriente, como procedimiento de despistaje, seguido de exámenes limitados al intestino delgado, puede dar mejores resultados que los logrados en el último decenio.

Preséntanse 6 casos de tumores malignos primarios del epitelio del intestino delgado.

Abrodil Myelography in Herniated Disk in the Lumbar Region[1]

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FOLLOWING THE REPORT by Arnell and Lidström (1) in 1931 dealing with the use of a water-soluble contrast medium (abrodil) in myelography, this method of examination has attracted ever-increasing attention, and it has been the subject of numerous articles (2–5). The irritant effect of the medium, necessitating spinal anesthesia, restricts its use in myelography to the lumbar spine. The main indication for abrodil myelography is thus herniated disk in the lumbar region, which, according to Dandy (6), occurs at the fourth or fifth lumbar interspace in 98 per cent of the cases.

The contrast medium used at the Department of Radiology of Rikshospitalet, Oslo, is a 20 per cent solution of "myelotrast AL," which is the chemical equivalent of abrodil, *i.e.*, the sodium salt of monoiodo-methane-sulfonic acid. This solution has a specific gravity of 1.130 and a pH of about 6.2. The technic employed at present is based on that described by Lindblom (7) and Klason (8) and is as follows:

The patient is placed on a tilting table resting on the affected side. Spinal anesthesia is effected by 0.05 to 0.10 gm. of novocain, following the aspiration of 10 ml. of cerebrospinal fluid. In most cases 0.05 gm. of the anesthetic has been found adequate. After ten minutes, with the puncture needle still in the dural sac, the head end of the table is tilted up to an angle of about 20°, and 7 to 10 ml. of the contrast medium are injected very slowly. More than 10 ml. should never be used.

Under fluoroscopic control, pictures are taken in five routine projections, horizontal rays being used: one projection with the patient in the lateral position, giving a frontal view, a second and a third projection with the patient turned ventrally 30° and 45°, respectively, a fourth projection with the patient turned 45° dorsally, and a fifth projection in the prone position, giving a lateral view. If there is special indication for examining the roots of the other side, the patient is turned accordingly.

Fig. 1. Arachnoidal adhesions following oil myelography eight years previously.

As soon as the films have been developed, they are studied in the dark room, since supplementary films, if needed, must be taken without delay. After the examination, the patient is placed in bed. He should lie with the upper part of the body

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elevated for at least two hours, during which period the contrast medium will be practically completely absorbed (9). In its complete absorption, abrodil posesses a great advantage over oily media which, by remaining in the subarachnoidal space, are apt to cause arachnoidal changes (Fig. 1).

At the Department of Radiology of the Rikshospitalet, we have performed between December 1947 and Jan. 1, 1950, a total of 208 myelographies in 188 patients. Of these patients, 88 presented definite clinical evidence of a herniated disk, while 89 presented but suggestive evidence. Myelography was performed also in 11 patients presenting evidence of other lesions. The myelographic findings in the 177 patients presenting clinical symptoms compatible with a herniated disk were as follows:

Myelographic Findings	—Number of Cases— Definite Clinical Evidence	Suggestive Clinical Evidence
Impression of the dural sac associated with root changes, *i.e.*, root displacement, widening of the root, and defective filling of the root sleeve	49	8
No impression, but defective filling of the root sleeve and widening of the root	13	0
No impression; defective filling of the root sleeve only	5	1
Slight impression in the lateral view; no root changes	8	21
Negative myelogram	11	56
Unsuccessful or unsatisfactory examination	2	3
TOTAL	88	89

A comparison of the clinical and myelographic findings with the operative findings follows:

Definite clinical evidence of a herniated disk and a positive myelogram were obtained in 75 patients, of whom 64 were operated upon. In 51 of these 64 patients, a herniated disk was found at operation. Other operative findings were a posterior osteophyte in 1 case and protrusion of the disk margin in 2 cases; 5 patients had negative explorations. In one of these 5 cases, however, where the fifth lumbar intervertebral disk was explored, the myelogram had demonstrated a small impression without root changes at the level of the third interspace. In another patient the lateral view showed impression of the dural sac coexistent with a degenerated disk associated with a retroposed vertebra.

Definite clinical evidence and a negative myelogram were obtained in 11 cases, in 7 of which operation was done. Of these 7 cases, 3 showed a small prolapse, and 1 showed a posterior osteophyte, while 3 explorations were negative.

Doubtful clinical evidence and a positive myelogram were obtained in 30 cases. Of 12 patients operated upon, 5 showed a herniated disk while in 7 the operative findings were negative. The myelographic finding in the 7 cases with negative explorations was slight impression of the dural sac in the lateral view without root changes, coexistent with a degenerated disk.

Doubtful clinical evidence and a negative myelogram were associated in 56 cases, in 7 of which operation was done. Of these 7 cases, 1 showed a small lateral prolapse, 1 showed a posterior osteophyte, and 1 adhesions around the root from a previous laminectomy; 4 explorations were negative.

The number of cases in which a prolapsed disk was removed totaled 65. The site of the lesion was the fifth interspace in 34 cases, the fourth interspace in 28 cases, the third interspace in 2 cases, and the second interspace in 1 case. In only a single case was there no definite narrowing of the corresponding interspace.

Disk prolapses up to the size of a pea we have termed "small," while larger ones we have termed "large." In the surgically verified cases of ruptured disk the myelographic findings were as follows:

	Large	Small	Total
Impression of the dural sac with root changes	35	11	46
No impression, but defective filling of the root sleeve and widening of the root	4	6	10
No impression, defective filling of the root sleeve only	3	2	5
Negative myelogram	0	4	4

Fig. 2. Normal myelogram. The roots and root sleeves are clearly seen.

Fig. 3. Marked impression of the dural sac. No filling of S_1 root sleeve, displacement of S_2 root within the dural sac. Operative findings: large lateral prolapse, compression and displacement of S_1 root.

Fig. 4. Left-sided sciatica for three years. No neurologic findings except for a positive Lasègue sign. Large impression and displacement of the roots. Operative findings: large lateral prolapse.

Fig. 5. Widening of L_5 root with defective filling of the root sleeve. Operative findings: lateral prolapse at the 4th interspace.

Fig. 6. Defective filling of the root sleeve of L_5. No impression of the dural sac. Operative findings: Lateral prolapse the size of a pea.

Fig. 7. Defective filling of the root sleeve of L_5 and widening of the root. Operative findings: Small lateral prolapse, L_5 root broad and flattened.

In all cases presenting a large medial prolapse the myelogram showed impression of the dural sac and root changes. In cases with defective filling of the root, the prolapse was situated laterally in 9 out of 10 instances. In all the 5 cases where the sole myelographic finding was defective filling of the root sleeve, the prolapse was situated laterally. Impression of the dural sac only, without coexistent root changes, was not encountered in any of the surgically verified cases.

In 6 cases myelography was repeated eight weeks to eighteen months after the operation. Negative myelograms were obtained in 3 of these cases. In 2 cases there was defective filling of the root sleeve, interpreted as a postoperative change. In 1 case myelography performed four months after the operation showed a complete block at the level of the interspace above that of the previous lesion. A second exploration, however, was negative.

The clinical course following myelography was especially recorded in 120 cases, representing 139 examinations. In 83 myelographies no side effects of any kind were noted, while in 56 one or more of the following symptoms occurred:

	Instances
Pain during injection of the medium	2
Headache, one to three days	14
Headache, seven days	1
Severe headache and neck rigidity	2
Convulsions and unconsciousness	3
Increased root pain for one or two days	20
Diffuse pain in the lower extremities for one or two days	11
Pain of shorter duration in the back and lower extremities	6
Abdominal pain for two days	1
Vomiting	5
Nausea	11

Pain during the injection of the contrast medium occurred in the same patient on the first and third occasions on which myelography was performed. The pain was localized to the posterior aspects of both thighs despite adequate anesthesia extending to the iliac crest. Headache was in most cases moderate and of a transient nature. Severe headache and neck rigidity occurred in only 2 cases and disappeared

within four to five days. Convulsions associated with unconsciousness, as observed in 3 cases, occurred two and a half, three, and three and a half hours, respectively, after the injection of the contrast medium. The convulsions were generalized and of a clonic nature and lasted for one to two minutes, consciousness returning after about fifteen minutes. In one of the cases the convulsions reappeared fifteen minutes later. In one instance, myelography had been performed two and a half months previously without the occurrence of complications except for slight headache and somewhat increased root pain. In another case, myelography was repeated some months later without complications of any kind. Of the 20 patients in whom increased root pain occurred, 16 showed prolapse at operation, while 2 of the 4 patients not operated upon showed myelographic evidence of a root lesion.

A number of the symptoms observed following myelography may be considered a result of the spinal anesthesia.

Postmyelographic spinal-fluid examinations were carried out in a few cases only. In one of the patients with severe headache and neck rigidity the following findings were obtained two days after myelography: cell count 900/cu. mm., Heller's test 1/10+, 1/15−; Pandy's test +++; Nonne's test +. Within the next day, however, the cell count had fallen to 280/cu. mm.; the Heller test showed 1/5−; Pandy's test +; Nonne's test +. In another patient, in whom but slight headache occurred following myelography, the following findings were obtained five days after myelography: cell count 58/cu. mm.; Heller's test 1/45+, 1/50−; Pandy's test +++; Nonne's test +. Increased protein content was found four months after myelography in one of the patients in whom convulsions occurred, and three weeks after myelography in 2 other cases. Normal spinal-fluid findings were obtained five weeks to eight months after myelography in 7 cases.

These few observations as to the changes in the spinal fluid following myelography do not permit definite conclusions. They indicate, however, that normal findings will scarcely be obtained until four to five weeks after myelography.

Fig. 8. Female of 18 years, with right-sided sciatica for one year. No impression of the dural sac. Widening of S_1 root and defective filling of the root sleeve. Operative findings: Lateral prolapse, S_1 root compressed.

COMMENTS AND CONCLUSION

The use of a water-soluble contrast medium in myelography is considered a most valuable method for the roentgenographic diagnosis and localization of a ruptured disk in the lumbar region. It provides adequate visualization of the root sleeves as well as of the dural sac (Figs. 2–7). Defective filling of the root sleeve, particularly when associated with widening of the root, is a most valuable sign by which those lateral prolapses which do not produce impression of the dural sac can be diagnosed (Fig. 8).

In cases where the clinical findings do not accord with the myelographic findings as to the level of the lesion, myelography proves its particular value. In our series

Fig. 9. Osteochondrosis with retroposition of the fourth lumbar vertebra and impression of the dural sac. Myelographic findings confirmed at operation; no prolapse.

the exact site of the lesion, myelography there were 6 such cases verified at operation. In 4 of these cases the prolapse was situated medially at the interspace corresponding to the one above that suggested by the clinical evidence but in accordance with the myelographic evidence. In these 4 cases the prolapse, due to its position, produced no symptoms from the root corresponding to that interspace. The remaining 2 cases showed a lateral prolapse associated with a lumbosacral transitional vertebra. In these cases an exact preoperative diagnosis would hardly have been possible without the aid of myelography.

In patients suffering from severe sciatic pain without symptoms or signs indicating may yield conclusive diagnostic evidence. In 4 of 5 such cases in which a prolapse was removed, the only positive clinical finding was a positive Lasègue sign. In the fifth case even this sign was missing, the only symptom being increased root pain during strain. In all these 5 patients myelography showed impression of the dural sac and root changes (Fig. 4).

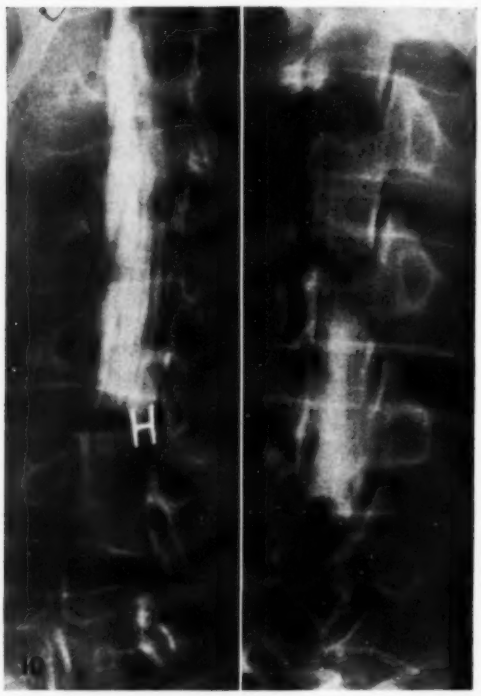

Fig. 10. Same case as in Fig. 5. Myelography four months after the operation. No filling of the dural sac below third lumbar interspace. Exploratory laminectomy at third and fourth interspace revealed no prolapse. The defective filling was probably due to operative changes.

Fig. 11. Block below third interspace ten days after an unsuccessful myelography. Exploratory operation revealed neither prolapse nor tumor. A repeated myelography three weeks later showed normal contrast filling of the dural sac.

In osteochondrosis, particularly in the presence of a coexisting retroposed vertebra, an anterior impression of the dural sac may be seen in the absence of a prolapse (Fig. 9). In the surgically verified cases of prolapse in our series, such filling defects were not observed except in asso-

ciation with myelographic evidence of root changes.

In 2 cases we observed a "false" defect in the column of contrast medium. One of these patients had been operated upon previously for a herniated disk (Fig. 10). In this case the filling defect might have been a result of the operative trauma. In the other case (Fig. 11) an unsuccessful myelography had been performed ten days previously. The filling defect in this latter instance might perhaps have been due to a blood clot produced by the previous lumbar puncture. Surgical exploration was negative, and a repeated myelography three weeks later showed no filling defect.

We have also used abrodil myelography for other purposes, *viz.*, for the roentgenographic localization of intradural tumors (Fig. 12) and for visualization of the dural sac in spondylolisthesis (Fig. 13).

Even though abrodil myelography occasionally may be followed by alarming symptoms, these have been of a transient nature in all our cases. We are confident that such complications may be reduced to a minimum or perhaps avoided by a careful technic. We consider it particularly important, for instance, that sudden movements of the patient be avoided during as well as after the examination, and that the upper part of the body be allowed to remain elevated when the patient is brought back to bed and for at least two hours thereafter. Having carefully observed these precautions, we have not seen any serious complications following abrodil myelography in the last ten months, during which period we have examined a total of 74 cases. We consider abrodil myelography a most valuable diagnostic aid and are encouraged to continue its use.

Fig. 12. Large filling defect caused by an intradural meningioma, confirmed at operation.

Fig. 13. Spondylolisthesis of the fifth lumbar vertebra. Note the increased distance between the dural sac and the displaced vertebra.

SUMMARY

The technic of abrodil myelography is briefly reviewed. The value of the method for the diagnosis of herniated disk in the lumbar region is discussed on the basis of a study of 208 myelograms. Of 65 cases in which a disk prolapse was removed, 61 showed definite myelographic evidence of the lesion, while in 4 cases in which a small lateral prolapse was found at operation the myelograms were negative. Abrodil is particularly useful for the visualization of the nerve roots and root sleeves, defective filling of the root sleeve and widening of the root being a valuable diagnostic sign.

It is concluded that abrodil myelography is a most useful method for the diagnosis as well as localization of a disk prolapse in the lumbar region, and that this procedure should be employed in all those cases where operative treatment may be indicated.

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SUMARIO

La Mielografía con Abrodil en la Hernia del Disco Intervertebral en la Región Lumbar

Repasada brevemente la técnica de la mielografía con abrodil, se discute el valor del método para el diagnóstico de la hernia de un disco intervertebral en la región lumbar, a base del estudio de 208 mielogramas.

De 65 casos en que se eliminó un prolapso del disco, 61 revelaron signos mielográficos bien definidos de la lesión, en tanto que los mielogramas resultaron negativos en 4, en que se descubrió al operar un pequeño prolapso lateral. El abrodil resulta en particular útil para la visualización de las raíces nerviosas y vainas de las raíces, constituyendo un valioso signo diagnóstico la presencia de nichos de las vainas y de dilatación de las raíces.

Dedúcese que la mielografía con abrodil es un método de lo más valioso para el diagnóstico así como para la localización de un prolapso de disco en la región lumbar, y que debe usarse el procedimiento en todos los casos en que puede estar indicado el tratamiento quirúrgico.

Roentgenographic Findings in Lesions of the Lingula[1]

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THE PURPOSE OF this communication is to describe certain roentgen findings characteristic of disease of the lingular division of the left upper lobe. Several authors (10, 12, 13) have stated that lingular lesions are difficult to diagnose roentgenographically. This has not been our experience. If certain criteria are kept in mind, a surprising number of lesions in this segment will come to light.

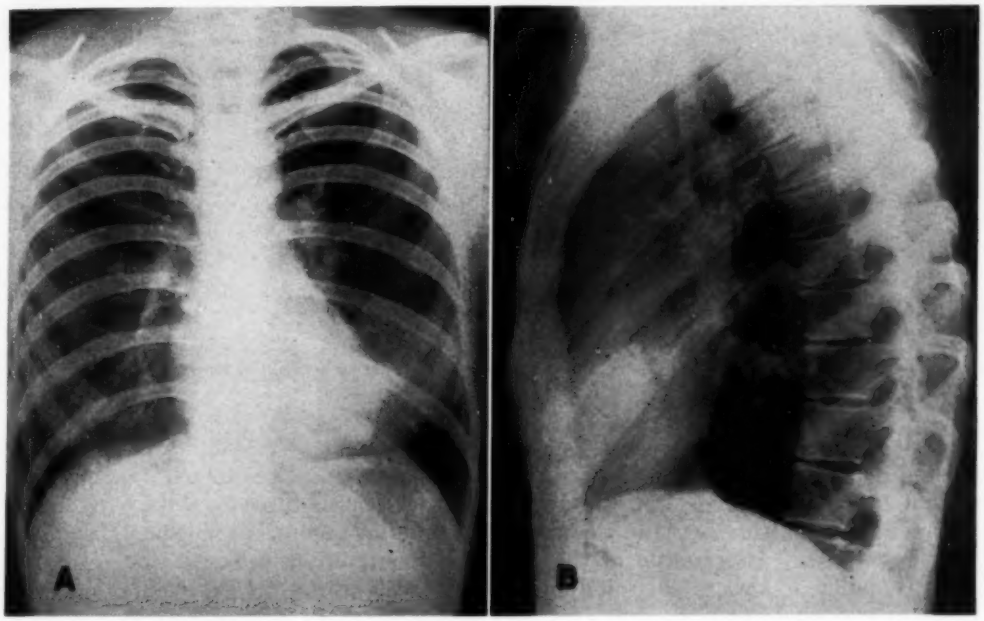

Fig. 1. A. Postero-anterior chest film. The consolidated lingula lies along the left cardiac border and is roughly triangular in shape. The cardiac border is poorly defined in its lower two-thirds.
B. Left lateral film of the chest. The shadow of the consolidated lingula is superimposed on the cardiac shadow and appears of greater density than that of the heart. The borders are not well delineated. The shadow is roughly triangular in shape, with apex toward the left hilus.

CLINICAL MATERIAL

Our observations are based on 31 patients with involvement of the lingula without significant disease elsewhere. Included are cases of bronchiectasis, atypical pneumonia, interstitial pneumonitis, cancer, chronic abscess, and chronic granuloma. Of the 14 cases of bronchiectasis, the majority went to surgery. Thus, there was opportunity for correlating the roentgen and surgical findings.

ROENTGEN FINDINGS

The normal lingula is the anteromedial segment of the left upper lobe adjacent to the left heart border. Medially it borders the pericardium, and laterally it approaches

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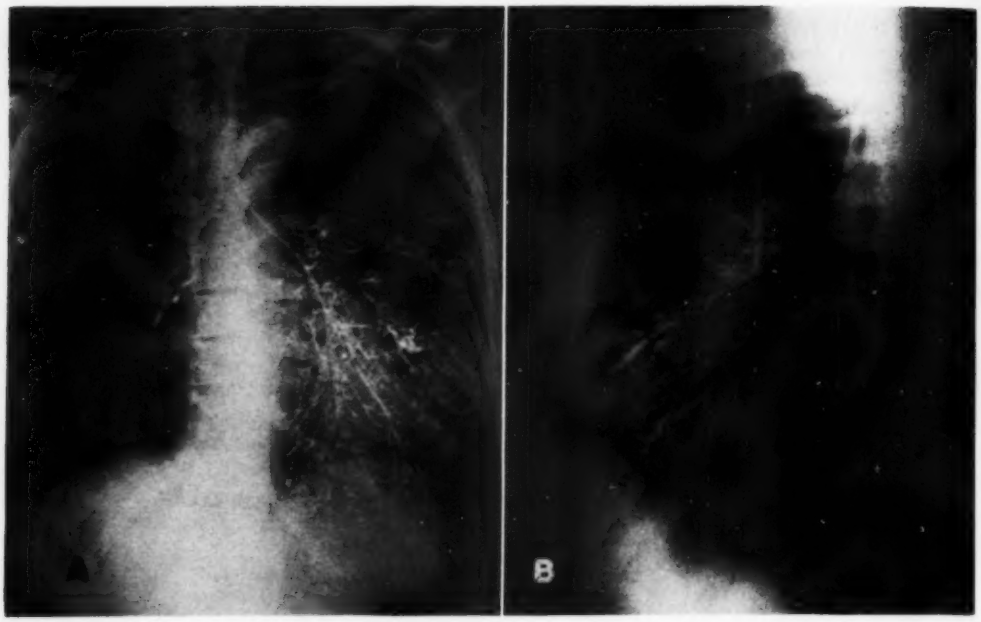

Fig. 2. A. Left-sided bronchogram in frontal projection. The superior and inferior divisions of the lingula are superimposed on the basilar divisions of the lower lobe. The lingular bronchi are difficult to evaluate on this film.

B. Left-sided bronchogram in lateral projection. The superior and inferior divisions are well visualized without superimposed bronchi. A tubular bronchiectasis is present. The iodized oil fails to reach the distal portion of the lingular border.

the lateral pleural wall; its anterior surface is against the anterior wall of the pleural space and its posterior surface is bounded by the fissure between the upper and lower lobes. Its position in the left chest is similar to that of the middle lobe in the right chest.

Generally, the lingula is supplied by the first branch of the upper lobe bronchus, which bifurcates into two divisions. These two divisions have been given several names; we prefer the terminology of Boyden (11) and Jackson and Huber (9), which designates them as "superior and inferior lingular divisions."

In the frontal projection, the normal lingula appears roughly triangular in shape, with a transverse superior border at the hilar level, a medial border against the heart, and an oblique lateral border extending downward and medially toward the diaphragm (Fig. 1A). In the lateral projection, the shadow is again triangular, with the apex at the hilus and the base on the diaphragm; it is largely superimposed on the heart shadow (Fig. 1B). In disease, its inferior extent is exceedingly variable, due to alterations in volume.

Lesions within the lingula are best studied with the combination of a routine frontal and lateral view. For further information, bronchograms are needed in certain types of disease, particularly bronchiectasis. Bronchographically the lingular bronchi are best visualized on films made in the left lateral (with iodized oil in the left side only) and right anterior oblique projections. The lingular bronchi on a frontal view are difficult to evaluate because of the superimposed basilar divisions of the lower lobe (Fig. 2A and B). Tomography may be indicated, especially in nodular and cavitating lesions. Angiocardiography is also useful when indicated, particularly in a study of the vascular alterations accompanying neoplasms.

When the lingula is diseased, certain characteristic changes are usually present. Infiltrations may be of any type observed in other parts of the lungs, including homogeneous consolidations, linear and patchy infiltrations, nodulations, and emphysema.

One outstanding finding, almost constantly present in the frontal view, is often

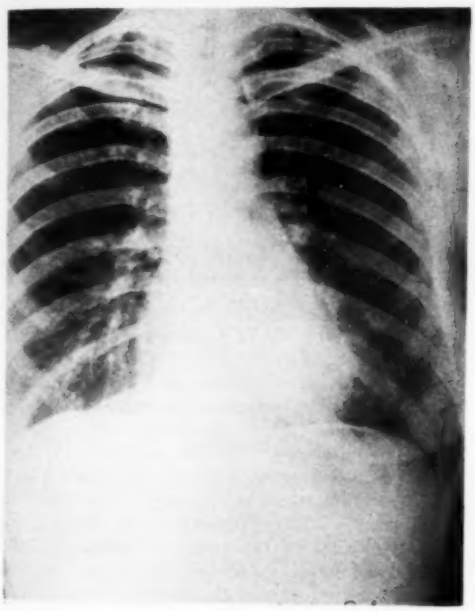

Fig. 3. Postero-anterior film of a patient with lingular bronchiectasis. There is distortion of the left cardiac border in its upper half. Pleuro-pericardial adhesions were found at surgery. A patchy consolidation is present in the lingula. Compare the poorly defined left cardiac border with the sharp definition on the right.

the first clue to the presence of a lesion, namely a partial or complete obliteration or distortion of the normally sharp left cardiac border (Fig. 3). The distortion is primarily due to pleuro-pericardial adhesions. These adhesions between the visceral pleura and the parietal pericardium have been noted in all but one of our surgically resected cases of bronchiectasis (Fig. 4). In the one case without adhesions, the frontal film showed a smooth cardiac border.

Poor definition without distortion of the cardiac border is most commonly seen in

Fig. 4. Appearance of pleuro-pericardial adhesions as seen at operation, frontal view. The left upper lobe, including the lingula, has been retracted laterally. In this case the adhesions extend from the lingula to the upper and middle portions of the left cardiac border.

acute lesions, such as virus pneumonia, and with complete healing there is a return of the sharp definition of the border (Fig. 5).

In acute diseases of the lingula, the segment usually is of normal volume. In chronic disease, however, it is subject to considerable variation in size. Normally the lingula extends to the diaphragm inferiorly, but with processes such as bronchiectasis and interstitial pneumonitis, in which atelectasis and fibrosis usually occur, contraction results and there is shrinkage toward the left hilus. The volumetric contraction determines the level of the pleuro-pericardial adhesions, and the extent of involvement roughly determines the lingular size. The lingular volume was increased in both of our cases of carcinoma. In one instance, this was due to infarction of the lingula beyond the lesion; in the other, to an extension of the malignant growth into the lingula.

On bronchographic exploration of the lingula, particularly for bronchiectasis,

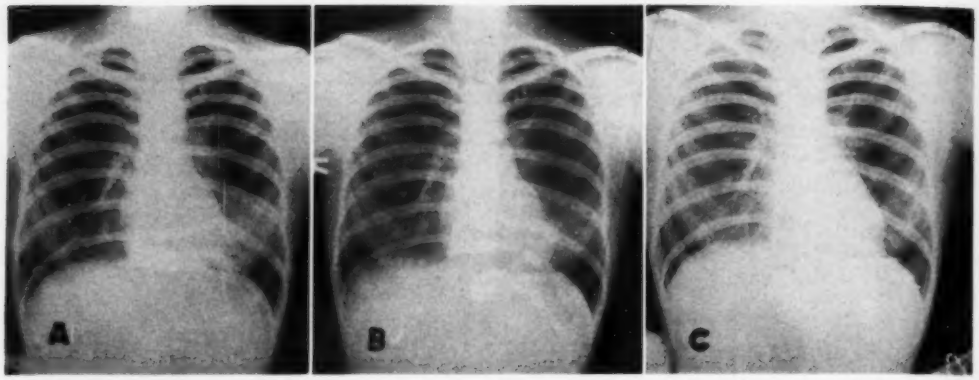

Fig. 5. Case I. A. Atypical pneumonia. Initial film in frontal projection. The lingula is consolidated and normal in size. The inferior half of the left cardiac border is obliterated.
B. Two weeks later the consolidation has regressed. The cardiac border is still obliterated.
C. Six weeks after the initial film, the consolidation has completely regressed, and the cardiac border is now sharply defined. The patient was free of all symptoms at this time.

considerable variation is seen in the degree of filling. The iodized oil may outline the bronchi throughout their entire extent. On the other hand, there may be filling for only half or a third of their extent (Fig. 2B), and in some cases not at all. We believe that failure of lingular filling is as important as good filling, provided the failure is not due to a technical fault. Failure to fill is usually due to obstruction by thick tenacious secretions, stricture, or neoplasm. Sometimes a diseased lingula will be well outlined on the lateral view by arborization of the oil into the small bronchioles and alveoli of the anterior division of the left upper lobe, and the medial and anterior basilar divisions of the lower lobe.

CASE REPORTS

CASE I: Mrs. C. W. H., white female, age 31. The previous history was entirely negative. Three weeks before the patient was seen, chills, fever, pain in the left anterior chest, malaise, and cough developed. These symptoms persisted for a period of approximately ten days, at the end of which time a physician was consulted. Physical examination showed râles and rhonchi over the left anterior and lateral chest. Roentgenographic examination revealed a consolidation of the lingula, and in the frontal view the cardiac border was obliterated in its lower half (Fig. 5A and B). Chemotherapy, including penicillin and streptomycin, produced little change in the symptomatology. The patient was then placed on aureomycin, and gradually she became asymptomatic. A final roentgenogram, six weeks after the initial films, revealed a complete clearing of the lingula (Fig. 5C).

CASE II: Mrs. C. V. J., white female, age 33, gave a history of recurrent episodes of chills and fever for a period of eight years. With these episodes, there was cough, productive of yellow mucoid sputum up to one-fourth of a cupful in twenty-four hours. On two occasions, the sputum was blood-streaked. There was recurrent pain in the left anterior chest, especially with episodes of pneumonitis. Physical examination revealed fine crepitant râles over the region of the lingula, anteriorly and laterally, and an occasional rhonchus which cleared on coughing. Routine films revealed a patchy consolidation of the lingula (Fig. 6A). Bronchographic exploration showed tubular dilatation of both superior and inferior divisions of the lingular bronchus. No oil penetrated the distal quarter of the bronchi (Fig. 6B).

Exploratory thoracotomy confirmed the diagnosis of bronchiectasis, and the lingula was removed segmentally. The postoperative course was satisfactory.

Pathological Diagnosis: Chronic bronchiectasis, chronic pneumonitis, and atelectasis of the lingular segment, left upper lobe.

CASE III: D. M. B., white male, 56 years old, gave a history of weight loss, fatigue, and anorexia of three months duration. He complained of recurrent pain in the left anterior chest, pleuritic in type, and cough with production of occasional blood-streaked sputum. Physical examination showed evidence of a wheeze, over the region of the lingular orifice, and left pleural fluid. Roentgenograms revealed a massive consolidation of the lingula (Fig. 7). Aspiration of the pleural fluid produced no evidence of tumor cells. Bronchoscopy showed an obstructing lesion in the lingular orifice. Biopsy

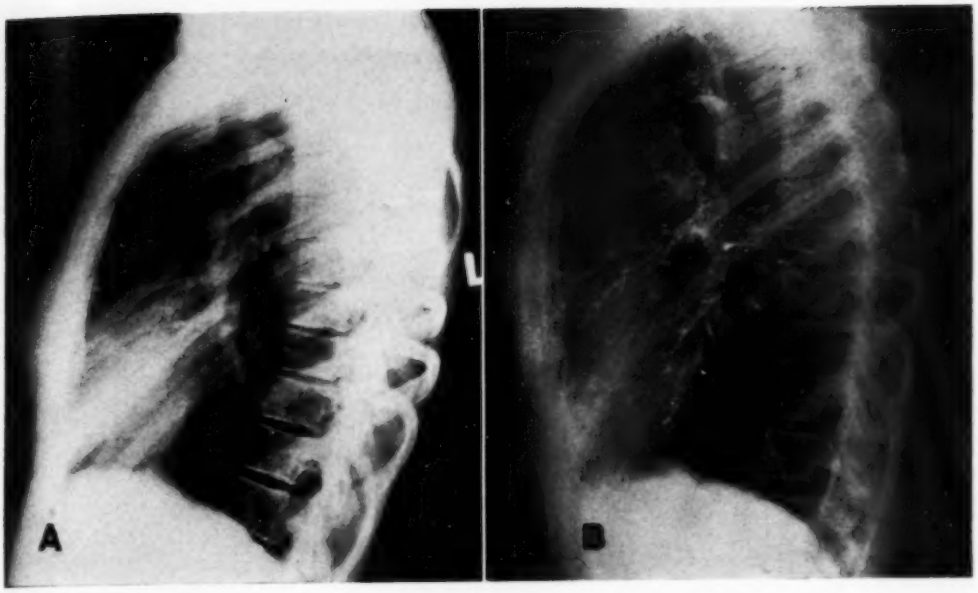

Fig. 6. Case II: Bronchiectasis. A. Left lateral roentgenogram. The lingula is consolidated, with the greatest density peripherally.

B. Left lateral bronchogram, showing tubular dilatation of both the superior and inferior divisions. There is failure of filling distally in the region of the greatest consolidation. The volume of the lingula is smaller than normal.

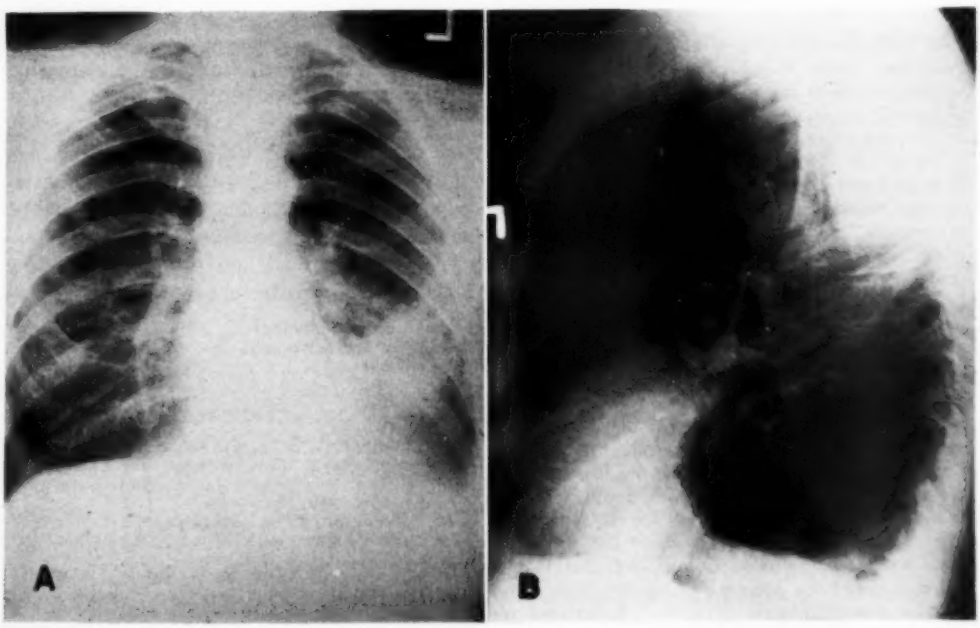

Fig. 7. Case III: Carcinoma. A. Postero-anterior view, showing massive consolidation of the lingula. There is fluid in the left pleural space.

B. Left lateral view. The triangular shaped area of consolidation is well defined both anteriorly and posteriorly. Note the increased volume of the lingular segment. The expansion of the lingula has distorted the major fissure.

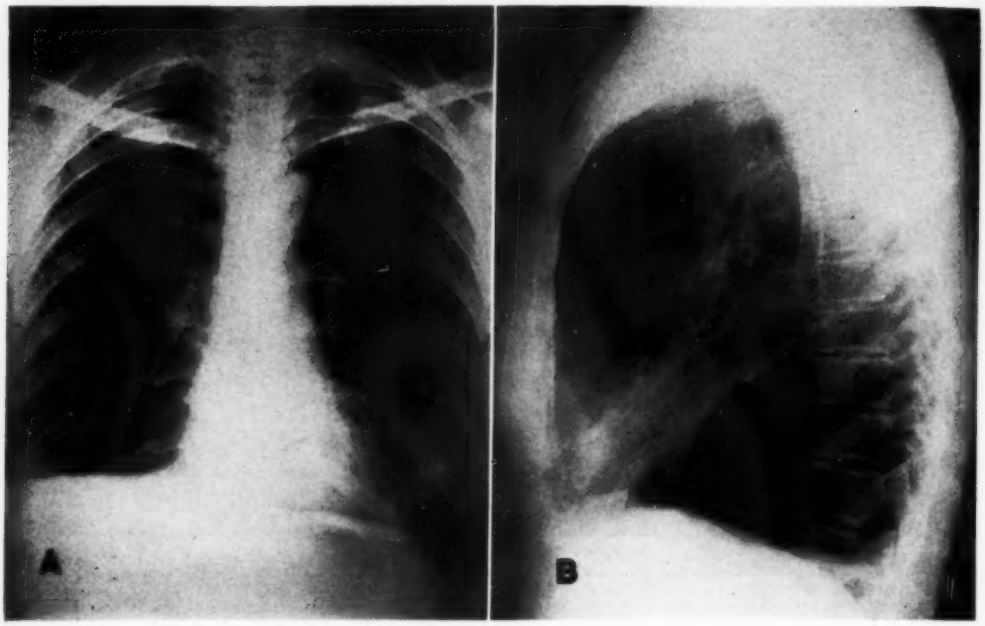

Fig. 8. Case IV: Interstitial pneumonitis. A. Frontal view, showing patchy consolidation of a small lingula. The left cardiac border is distorted.
B. Lateral view. A patchy consolidation is superimposed on the cardiac shadow. The borders of the consolidation are poorly defined.

of the bronchus led to a diagnosis of epidermoid carcinoma, grade II. Exploratory thoracotomy revealed a tumor in the region of the lingular orifice, and a total pneumonectomy was done. The postoperative course was uneventful.

Pathological Diagnosis: Epidermoid carcinoma, Grade II, involving the lingular orifice, with atelectasis and infarction of the lingular segment distal to the cancer.

CASE IV: Mrs. W. J. D., 44-year-old white female. Sixteen years previously this patient had suffered a massive pulmonary hemorrhage for which she was hospitalized. A diagnosis of abscess of the left lung, non-tuberculous in nature, was made. There had been two other slight pulmonary hemorrhages since, one seven years and the other four years before admission to the hospital. One month before admission there was another small hemoptysis. Physical examination revealed a wheeze over the region of the lingula, both anteriorly and laterally. Sputum studies were negative for tuberculosis. Roentgenograms in frontal and lateral projections showed the presence of patchy consolidations in a small lingula (Fig. 8). Bronchoscopy showed edema and thickening of the lingular orifice of the left upper lobe. A segmental resection of the lingula was done. The postoperative course was uneventful.

Pathological Diagnosis: Chronic interstitial pneumonitis, with many areas of lymphocytic infiltration, epithelial and giant cells.

SUMMARY

1. The salient roentgenographic findings in lesions of the lingular division of the left upper lobe are discussed.

2. The clinical and roentgenographic findings in four cases are described.

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SUMARIO

Hallazgos Roentgenográficos en las Lesiones de la Língula

A base de sus observaciones en 31 enfermos con varias lesiones in la región lingular del lóbulo superior del pulmón izquierdo, pero sin enfermedad significativa en ninguna otra parte, los AA. describen los típicos hallazgos roentgenológicos observados cuando se afecta ese segmento pulmonar. Se emplean las vistas frontales y laterales de costumbre, con la broncografía y la tomografía, según estén indicadas.

Las infiltraciones pueden revestir cualquiera de las formas observadas en otras partes del pulmón, incluso hepatización homogénea, infiltraciones lineales y en placas, nodulaciones y enfisema. Un hallazgo sobresaliente y casi constante en la vista frontal consiste en obliteración o deformación, debido primordialmente a adherencias pleuropericardíacas, del borde izquierdo, normalmente agudo, del corazón. En las lesiones agudas, suele haber mala definición sin deformación del borde cardíaco, y el segmento posee su volumen normal en la mayor parte de los casos. En las afecciones crónicas, la língula es susceptible de considerables variaciones en su tamaño; puede hallarse contraída en estados tales como bronquiectasia y neumonitis intersticial; en los 2 casos de los AA., de carcinoma del orificio lingular, había aumento de tamaño. En el examen broncográfico, varía el grado en que se llenan los bronquios. La falta de henchimiento suele deberse a obstrucción por secreciones, espesas y tenaces, estenosis o neoplasia.

Comunícanse 4 casos.

Bronchogenic Cysts[1]

COL. R. J. HEALY, M.C., A.U.S.[2]

SINCE THORACOTOMY has become a more common surgical procedure, bronchogenic cysts are being found more frequently. The 19 cases composing the series upon which the present paper is based were treated at the Walter Reed Army Hospital during the past six years and have been proved by surgical excision and pathologic examination. Most of the published reports on this subject refer to mediastinal cysts. In this series, however, 40 per cent of the cysts were intrapulmonary.

Bronchogenic cysts are true cysts, since they contain fluid and have an epithelial lining. They should therefore be differentiated from non-epithelialized cystic lesions.

This benign cyst usually appears as a solid mass on the x-ray film. Differentiation of the fluid-filled cyst, either in the mediastinum or lung, from a malignant neoplasm is usually quite difficult and thoracotomy is indicated even in the asymptomatic cases.

When the cyst communicates with a bronchus, as occurred in 20 per cent of this series, the differentiation from a solid neoplasm is easier, since the cyst will contain both fluid and air. A presumptive diagnosis is made on the roentgen findings, but a final diagnosis rests on pathologic study of the excised cyst.

PATHOGENESIS

Most writers agree that bronchogenic cysts arise as developmental anomalies of the tracheobronchial tree in the embryo. Theories of origin include: a pinching off of a diverticulum of entoderm and mesoderm from the foregut in the region of the tracheal bud, a secondary budding of the tracheal bud itself, and an abnormal division in a later stage of development of the tracheobronchial tree.

Since the lining membrane of the cyst contains mucous glands, there is a gradual accumulation of mucus within the cyst and a corresponding increase in size as the patient grows older. The cyst is too small to cause symptoms or be detected on the chest film during childhood and therefore is rarely reported in that period.

PATHOLOGY
(*Average Case*)

The soft, flexible, fluid-filled mass, is ovoid in shape and its smooth outer surface is gray-brown in color. A short (1 cm.) vascular pedicle serves as the point of attachment to a bronchus or the trachea. Cross section of the cyst reveals a wall 2 to 4 mm. thick. Within the cavity is a viscid "pea soup" fluid which is of gray to brown color and appears to be a mixture of mucus and degenerated blood. These cysts vary from 1 to 9 cm. in diameter. The cavity is usually single, but is sometimes divided by septa. The inner lining membrane is grayish white in color, smooth and moist.

Microscopically the lining membrane is seen to consist of ciliated, stratified cuboidal or columnar epithelium with mucous glands. The wall is made up chiefly of fibrous tissue, with some muscle fibers, islands of cartilage, nerves, and blood vessels. It resembles the normal bronchial wall. There is no evidence of malignant change.

CLINICAL FINDINGS

All of the patients in the present series were adults; 3 were females and 16 were males. About 50 per cent of the patients were asymptomatic, the lesion being found on a survey film. Physical examination of the chest is usually negative.

Pressure symptoms such as dyspnea, cyanosis, cough, wheezing, chest pain,

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[2] Chief of the Diagnostic Section, Radiological Service, Walter Reed Army Hospital, Washington, D. C.

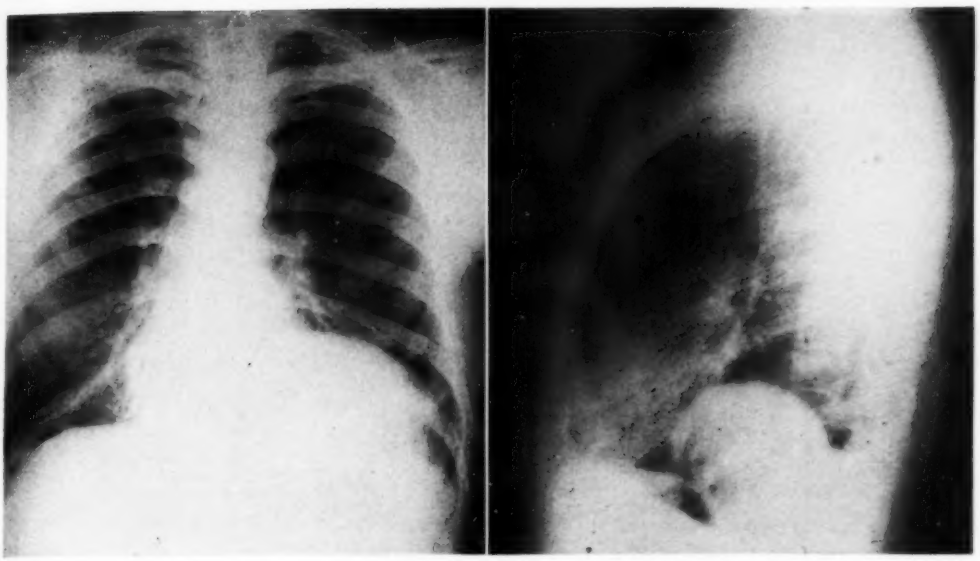

Fig. 1. Case I. Male, age 36, asymptomatic. Single thin-walled cyst filled with a gray mucoid material. This was the largest cyst in the series.

and dysphagia vary with the size and location of the cyst. If infection supervenes, chills, fever, cough—usually productive—and leukocytosis appear.

Most of the patients presenting symptoms recalled previous episodes of illness which had been diagnosed as bronchitis, asthma, pneumonitis, lung abscess, or other chest condition.

ROENTGEN FINDINGS

Roentgenographically the cyst is demonstrable as a mediastinal or intrapulmonary mass, ovoid in shape and of homogeneous density, though occasionally fluid and air may be distinguished. The margin is smooth and discrete and the surrounding lung field is usually normal. Most of the cysts are single. The location may be anywhere along the trachea or larger bronchi, from the sternal notch to the diaphragm. In a few instances a gradual increase in size has been observed. The shape may change with inspiration and expiration. Of these findings, those of chief diagnostic significance are the ovoid shape and the change on inspiration and expiration films. The shape is accounted for, theoretically, by the single point of attachment to the bronchial tree and the gravitational pull of the fluid contents.

Fig. 2. Case II. Male, age 43, with mild dysphagia. Preoperative diagnosis: Substernal thyroid. Surgery revealed an oval fluid-filled cyst, 7 cm. in diameter, attached to the trachea and producing deviation of the esophagus.

Fluoroscopy may show (*a*) movement of

Fig. 3. Case III. Male, age 33, asymptomatic. Note increase in size of cyst as seen in film B, taken seventeen months after A.

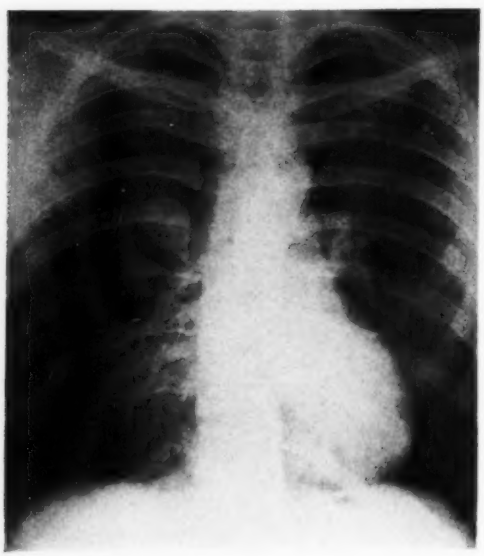

Fig. 4. Case IV. Male, age 32, asymptomatic. Oval, fluid-filled, thin-walled cyst arising from right main stem bronchus.

the cyst on swallowing, if it is attached to the trachea, (*b*) deviation of the barium-filled esophagus when the cyst is located in the posterior mediastinum, (*c*) transmitted pulsation if the cyst lies adjacent to the heart or great vessels.

Bronchograms are of little diagnostic aid, since they usually reveal only displacement of the bronchi by the mass. An occasional cyst may partially fill with the opaque medium, thereby demonstrating its cystic nature; the plain film, however, will show such cysts to contain both fluid and air.

SUMMARY

A group of 19 cases of bronchogenic cysts has been reviewed, in patients ranging from eighteen to fifty-one years of age, 16 of whom were males.

The cysts are thin-walled, lined with bronchial epithelium, ovoid in shape, and usually filled with fluid. They may be either mediastinal or intrapulmonary.

There are no symptoms until the cyst grows large enough to produce a pressure disturbance of an adjacent organ or becomes infected.

An important diagnostic point is the ovoid shape of the cyst. This was apparent in all but one case in this series, either in the postero-anterior or lateral film. A second diagnostic point, although less commonly seen, is the change in shape on inspiration and expiration films. The

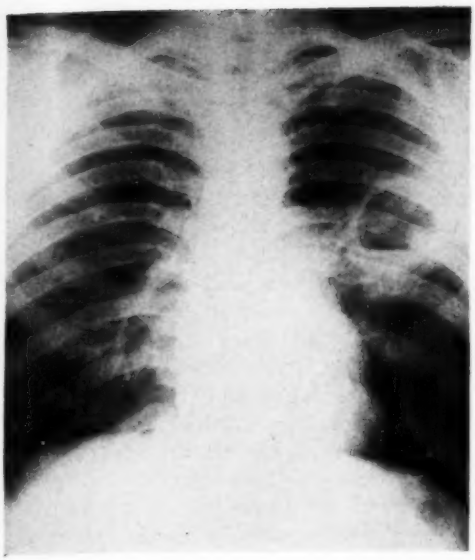

Fig. 5. Case V. Male, age 30, with recurrent episodes of chills and fever and productive cough. Infected cyst containing air and fluid. The cyst is in direct communication with a bronchus. Such a lesion is often confused with a pulmonary abscess.

final diagnosis rests on the pathologic study of the excised cyst.

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SUMARIO

Quistes Broncógenos

El grupo repasado comprende 19 casos de quistes broncógenos en enfermos cuya edad variaba de dieciocho a cincuenta y nueve años, y 16 de los cuales eran varones.

Esos quistes tienen paredes delgadas, están recubiertos de epitelio bronquial, son ovoideos y suelen estar llenos de líquido, pudiendo ser ya mediastínicos o intrapulmonares.

No hay síntomas hasta que el quiste o se desarrolla lo suficiente para producir trastornos por compresión de un órgano adyacente o se infecta.

Un importante punto diagnóstico consiste en la forma ovoidea. Esta fué manifiesta en todos los casos, menos uno, de la serie, ya en la radiografía posteroanterior o lateral. Otro punto diagnóstico es el cambio de forma en las radiografías tomadas al inspirar y al expirar aire. El diagnóstico definitivo reposa en el estudio patológico del quiste excindido.

Herniation of the Lung in the Cervical Region[1]

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TWO CASES OF HERNIATION of the lung in the cervical region, immediately posterior to the clavicle, observed within the past year, seem worthy of reporting, not only on account of the rarity of the condition, but more especially because of the roentgen findings. Second in frequency of the three types of lung hernia, this type accounts for 20 to 28 per cent of a total of some 200 cases appearing in the literature (1, 2, 3). The site most commonly affected is the thoracic or intercostal region, the number of such cases amounting to nearly 72 to 80 per cent, while only one case has been recorded (in 1882) of herniation through the diaphragm (4).

Hernia of the lung occurs more frequently in males than in females, the ratio, based on conservative estimates, being three to one (1). The patients are usually over 45 or under 15 years of age, only 31 per cent of the cases occurring between those ages. The prognosis is good. Surgery is the most effective procedure, combined with treatment of the underlying condition and change of occupation if necessary.

Etiologically lung hernias are classified as congenital or acquired (2). The latter include those occurring spontaneously, as a result of trauma, or as the result of a pathologic condition of the thoracic wall. Spontaneous hernias, which constitute about 33 per cent of the acquired type (1), appear to be associated with weakness of the chest wall plus increased intrathoracic pressure and may develop after a long-continued cough, after constant blowing as in playing a wind instrument or in glass blowing, after undue exertion such as lifting a heavy object, after straining at stool, or after labor. In a sense, this type is due to a combination of congenital and spontaneous factors. Van Wezel's (5) recent report of cervical hernia occurring in a 39-year-old male who had had a cough for several winters, associated with a progressive bronchitis, is an example of the dual role of congenital and spontaneous causes. The author attributed the hernia to deficiency in the vertebropleural ligament, that is, Sibson's fascia.

The pathologic and the spontaneous types also overlap. Among the pathologic causes, in addition to bronchitis, as in Van Wezel's case, are chronic bronchiectasis and whooping cough. Congenital absence of muscles may be responsible for the condition in individuals subjected to undue increase in air pressure within the lungs. Hernia in the cervical area usually occurs between the scalenus anticus and sternomastoid muscles. A tendency toward protrusion in this area is controlled by the parietal pleura, the neck muscles, and the cervical fascia. Weakness or deficiency of any of these factors predisposes to hernia.

The outstanding symptom is the occurrence of a mass, which appears with the Valsalva maneuver and abates with inspiration. Rarely is it painful (3, 5), although Montgomery and Lutz (1) found that local pain and cough develop insidiously. Local inflammation may be present in the incarcerated, non-reducible types. A tympanic note is heard on percussion. Palpation of the mass elicits crepitus, and grasping the lung causes vesicular whistling and crackling râles. Often the tip of the finger can be inserted into the orifice and the mass can be reduced. Breath sounds are heard on auscultation.

Roentgenograms reveal the presence of air in the herniated mass. Films taken during forced expiration against a closed glottis show a prominent tumor, which is

[1] Accepted for publication in January 1951.

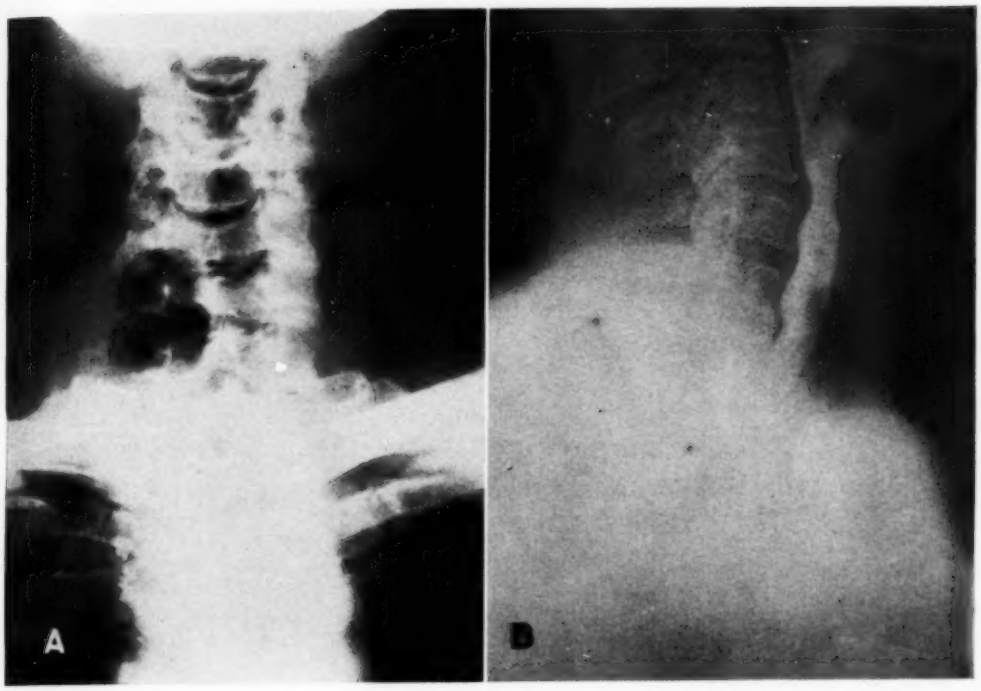

Fig. 1. Case I. A. Postero-anterior film (enlarged), showing a rounded radiolucent mass representing the herniated lung.
B. Lateral view, showing lung hernia in relationship to structures in the neck.

no longer present in a film taken on inspiration unless the hernia is irreducible and incarcerated. Differentiation must be made from (*a*) infections with gas-forming organisms, (*b*) subcutaneous emphysema, in which the gas shadows show no discriminating boundaries and no changes occur with respiration, and (*c*) tumors, inflammatory masses, and empyema. In these last conditions air is usually not present and rib destruction and pulmonary infiltration may be observed.

CASE REPORTS

CASE I: A 42-year old white male presented himself because of a chronic, non-productive cough. His past history was non-contributory except that fifteen years previously he had been flung over the handlebars of his motorcycle when it struck a tree. He landed on the back of his skull and neck and was unconscious for a short time. He was not hospitalized and made an uneventful recovery at home. There was no injury to the right shoulder girdle or to the right cervical region.

Physical examination revealed a soft, rounded mass in the right supraclavicular fossa. This mass, approximately 5 cm. in diameter, enlarged and became more prominent upon performance of the Valsalva maneuver. It was crepitant to touch and transmitted vesicular breath sounds. It could not be completely reduced.

Roentgen examination of the chest disclosed the presence of a pulmonary hernia into the right supraclavicular fossa. The herniated lung measured 4 × 4 × 5 cm. and was situated anteriorly, lying mainly alongside the trachea. Otherwise the chest was not unusual. The patient's cough was believed to be due to a chronic bronchitis and in no way associated with the hernia. However, in a patient who may have injured Sibson's fascia in an accident sustained fifteen years earlier, chronic cough is probably a contributing etiologic factor.

CASE II: A 47-year old white male was seen in a cancer detection clinic because of a right supraclavicular mass. The past history was essentially non-contributory. The patient had first discovered the mass a few months previously. It was never painful.

Physical examination revealed a soft, well circumscribed, non-tender, right supraclavicular mass about 8 cm. in diameter. This appeared only with the Valsalva maneuver and disappeared upon ex-

Fig. 2. Case II. A. Cervical hernia of lung with boundary of hernia marked by arrows. This was present only upon performance of the Valsalva experiment.
B. Film obtained with higher kilovoltage technic to give greater gradations of contrast of soft tissues.

piration and normal inspiration. It was crepitant to palpation and transmitted vesicular breath sounds.

A chest film revealed a herniation of the lung into the right supraclavicular fossa. This corresponded to the palpable mass.

No etiologic factor could be established in this case, and it was assumed that the hernia was secondary to a congenital weakness of the vertebropleural ligament.

SUMMARY

Two cases of herniation of the lung in the cervical region, immediately posterior to the clavicle, are reported.

Herniation of the lung may be congenital or acquired. Congenital hernias are associated with weakness of the chest wall and increase in intrathoracic pressure. The acquired types may be spontaneous, in which event there is usually an underlying congenital weakness of the chest wall, or they may be the result of weakening of the thoracic wall by trauma or disease.

Roentgenograms taken during forced expiration against a closed glottis show a prominent tumor, which is no longer present in a film taken on inspiration, unless the hernia is irreducible and incarcerated. Air is demonstrable in the herniated mass.

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SUMARIO

Hernia del Pulmón en la Región Cervical

Los 2 casos comunicados son de hernia del pulmón en la región cervical, inmediatamente detrás de la clavícula. La hernia pulmonar puede ser congénita o adquirida. Las hernias congénitas se asocian con debilidad de la pared torácica y aumento de la presión intratoracia. Las formas adquiridas pueden ser espontáneas, en cuyo caso suele haber una subyacente debilidad congénita de dicha pared, o pueden ser efecto de un debilitamiento de la jaula torácica por traumatismo o enfermedad.

Las radiografías tomadas durante la expiración forzada contra una glotis cerrada muestran un tumor sobresaliente, que no aparece después en una radiografía tomada al inspirar, a menos que la hernia sea irreducible e incarcerada. En la tumefacción herniada puede observarse aire.

The Recumbent Esophagogram

An X-Ray Method for Early Detection of Left Atrial Enlargement[1]

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EARLY ROENTGENOLOGIC recognition of left atrial enlargement is desirable, as diagnosis may depend upon this knowledge. Enlargement of the left atrium is an almost constant finding in disease of the mitral valve. This chamber may be the only one affected, at least at the early stages of this valvular lesion. Sosman considered dilatation of the left atrium as an indication of mitral stenosis even in the absence of typical auscultatory findings.

The cardiac configuration in rheumatic mitral stenosis is, as a rule, sufficiently distinct in conventional roentgenograms to suggest the diagnosis. In the early stages of mitral valvular disease, however, the size and contour of the heart may appear normal on the postero-anterior roentgenogram, as the enlargement of the left atrium may be hidden in the cardiac shadow. On the other hand, as Roesler points out, the term "mitral configuration" is purely descriptive and does not necessarily indicate that the mitral valves are affected. Such a configuration is seen physiologically in some young individuals, especially of the asthenic type. It is also found in association with emphysema, with fibrotic processes of the left upper lobe of the lung, and in certain congenital cardiovascular malformations, in instances where the mitral valves are not involved and no left atrial enlargement is present.

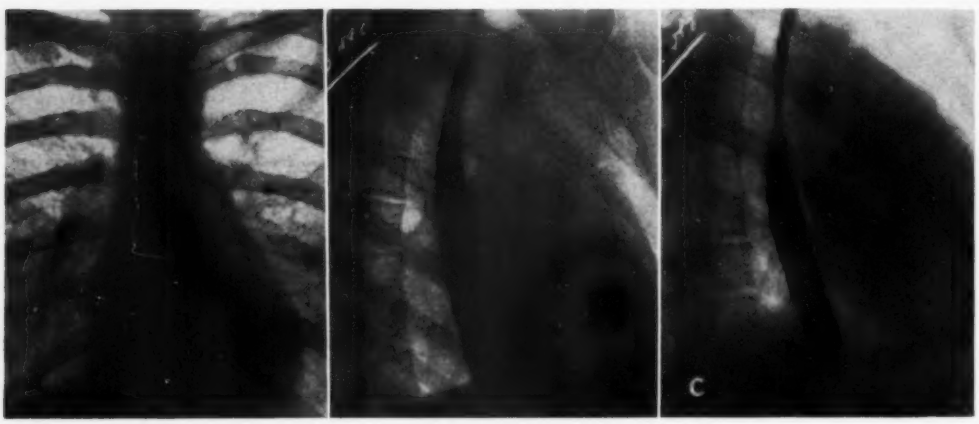

Fig. 1. Z. M., female aged 20 years, with no heart complaints. A. Postero-anterior roentgenogram, showing normal configuration of the heart. The barium-filled esophagus follows a straight course in both the erect (B) and the recumbent (C) right anterior oblique position.

The left atrium forms the posterior surface of the heart. The esophagus follows a vertical course directly behind and in apposition to it. The order of sequence of left atrial enlargement is as follows: first, posterior dilatation into the retrocardiac space; later to the right, superiorly; and finally to the left. Thus far, the criterion most frequently used for demonstration of such enlargement is a localized posterior displacement of the barium-filled esophagus

[1] From the Diagnostic X-ray and Medical A. Departments of the Hadassah University Hospital and Hebrew University Hadassah Medical School, Jerusalem. Accepted for publication in December 1950.

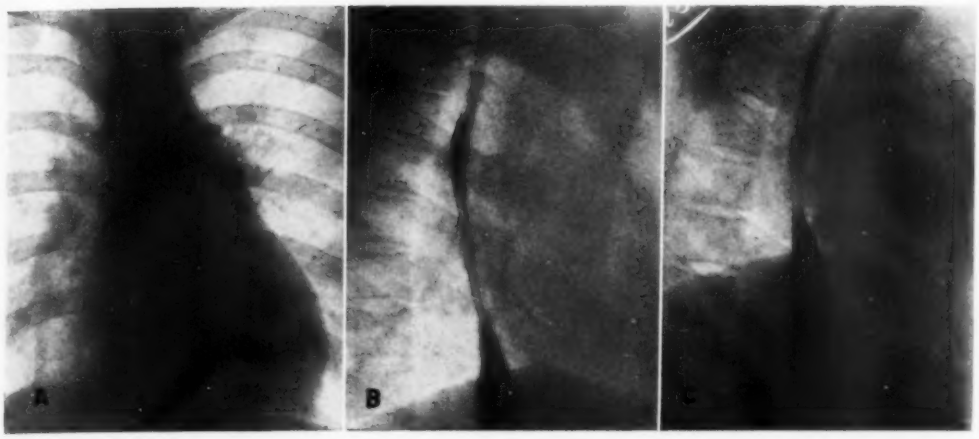

Fig. 2. C. C., male aged 24 years, with palpitation and slight dyspnea on exertion, slight systolic murmur at the apex, and accentuation of the second pulmonary sound. Clinical impression: Congenital heart disease; probably interatrial septal defect. A. Postero-anterior roentgenogram, showing bulging at the pulmonary segment. No deviation of the esophagus is demonstrable in either the erect (B) or recumbent (C) position.

at the appropriate site, *i.e.*, approximately in the middle third. This is demonstrated routinely in the right anterior oblique position with the patient erect.

Minor degrees of left atrial enlargement may conceivably escape detection, if the barium swallow is given with the patient erect, the volume of the heart being decreased by lesser venous return (Larsson and Kjellberg). In the recumbent position, however, the left atrium, along with the other chambers, is filled with a greater amount of blood and, as a result of gravity, comes into closer relation with the esophagus. This position may, therefore, provide a possibility of demonstrating even minor degrees of atrial enlargement. Such enlargement would be visualized by the localized posterior displacement of the barium-filled esophagus in the *recumbent right anterior oblique* position. Assuming, consequently, that such retrodisplacement might be seen at a time when the enlargement of the left atrium is still insufficient to encroach upon the esophagus in the erect position, the following study was undertaken.

The relation of the left atrium to the barium-filled esophagus was studied in the right anterior oblique view with the patient erect and recumbent, as well as in the postero-anterior teleroentgenogram. Four groups of individuals were examined: (A) with normal hearts; (B) with so-called "mitral configuration" of the heart, without clinical evidence of mitral valvular disease; (C) patients presenting definite clinical as well as roentgenologic findings indicative of mitral valvular disease; (D) patients presenting equivocal or only suggestive evidence of mitral valvular disease, clinically as well as roentgenologically.

Roentgenograms were taken in preference to fluoroscopic observations for more exact comparison and study. Clinical and roentgenologic examinations were carried out separately by the authors (S. S. and A. S., roentgenologists; F. D., cardiologist) in order to evaluate the respective findings independently.

RESULTS

The three exposures taken of a number of individuals of Group A (normals) and of Group B ("mitral configuration" without mitral valvular disease) showed that the barium-filled esophagus runs a straight course without any deviation in the right anterior oblique position, either erect or recumbent (Figs. 1 and 2).

In Group C (cases of proved mitral valvular disease), on the other hand, the

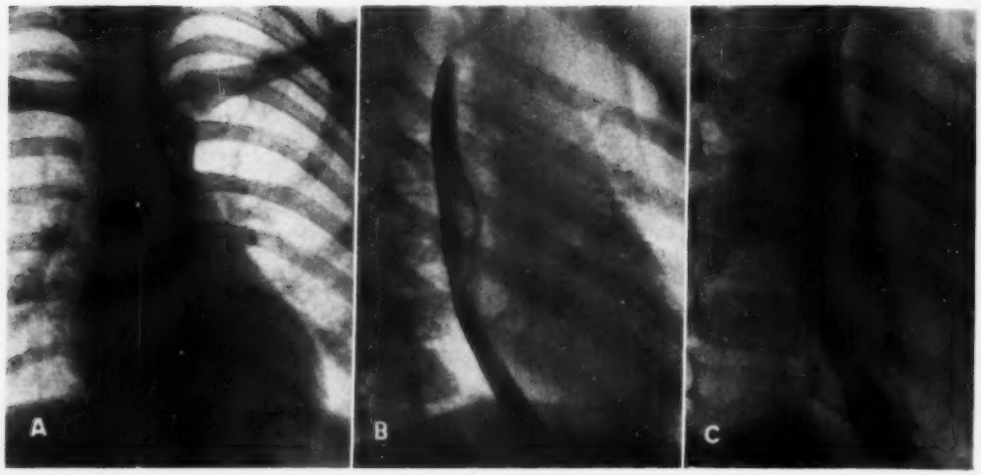

Fig. 3. K. S., female aged 7 years, with a history suggestive of rheumatic fever. Clinical impression: Mitral stenosis. A. Postero-anterior roentgenogram, showing straightening of the left heart border and rounded apex. B. Right anterior oblique erect esophagogram, showing distinct retrodisplacement of the esophagus. C. Right anterior oblique recumbent esophagogram, showing still more marked displacement.

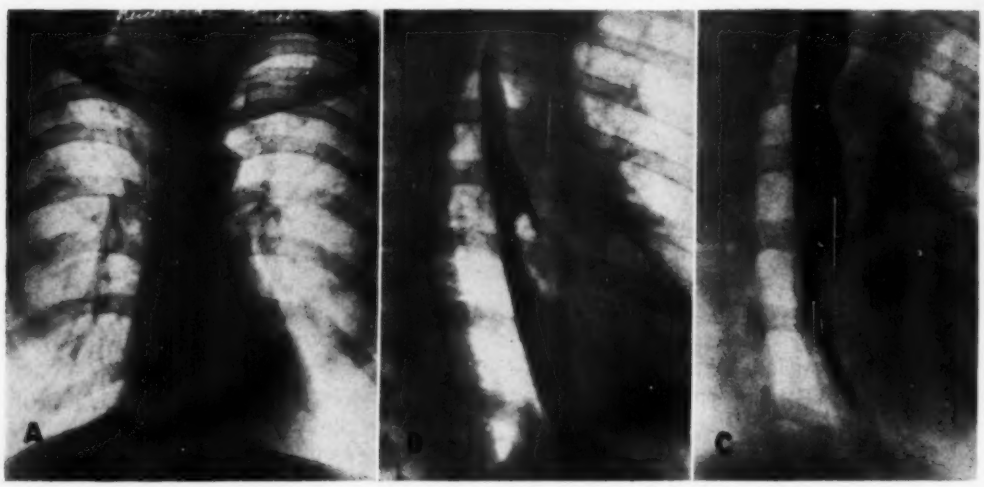

Fig. 4. P. R., male aged 30 years, with questionable clinical findings as to the existence of mitral disease. A. Postero-anterior roentgenogram, showing normal configuration of the heart. B. Right anterior oblique erect esophagogram showing no deviation of the esophagus. C. Right anterior oblique recumbent esophagogram, showing definite localized retrodisplacement.

barium-filled esophagus deviated backward more markedly in the recumbent than in the erect right anterior oblique position (Fig. 3).

In Group D (clinically suggestive mitral valvular disease), cases were encountered in which the barium-filled esophagus either did not deviate at all in the erect right anterior oblique position or showed only a doubtful deviation. With the patient recumbent, however, the esophagus was definitely displaced posteriorly (Figs. 4–7). This finding preceded any other roentgenologic evidence of mitral disease (Figs. 4 and 5).

During the course of our study, a paper

DISCUSSION

Retrodisplacement of the barium-filled esophagus in the recumbent right anterior oblique position has been demonstrated in cases where it was apparent also in the erect right anterior oblique position. The displacement proved, however, to be of greater degree in the recumbent than in the upright position. This in itself renders it likely that the recumbent position may bring out left atrial enlargement more distinctly than the routine erect view. This retrodisplacement of the esophagus in the recumbent position was proved to be absent in normal subjects. It was clearly demonstrable, however, in cases where clinical and x-ray evidence indicated or

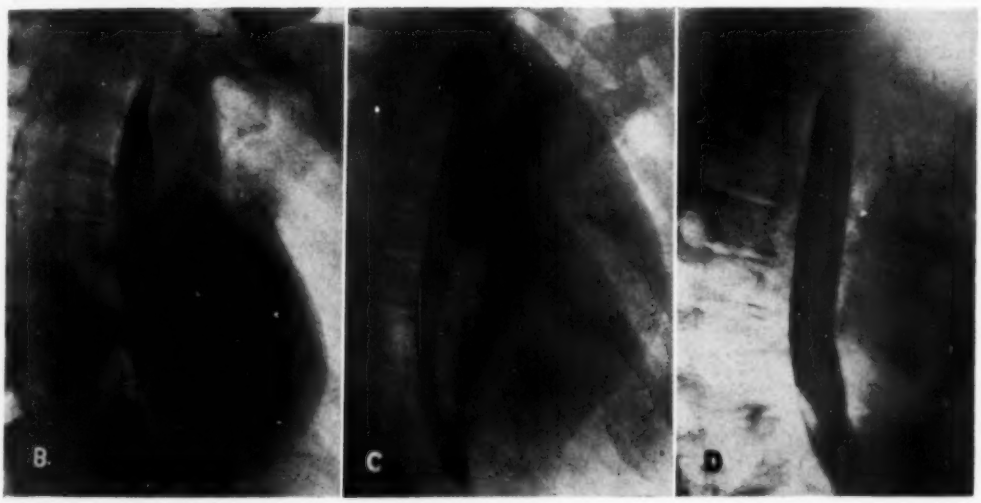

Fig. 5. E. M., female aged 40 years, with palpitation, precordial pain, dizziness, slightly increased cardiac dullness in the second left interspace, and accentuation of the second pulmonary sound. A. Postero-anterior roentgenogram showing normal heart configuration. B. Right anterior oblique erect esophagogram, showing no deviation of the esophagus. C. Right anterior oblique recumbent esophagogram, showing distinct retrodisplacement. D. Lateral prone esophagogram, showing minimal deviation only.

of Kjellberg came to our attention, advocating study of the barium-filled esophagus in lateral views taken with the patient prone. On comparing the deviation of the esophageal line in the prone position, as advocated by Kjellberg, with the displacement in the recumbent right anterior oblique position, a more definite deviation in the latter position was observed (compare Figs. 5C and 5D). strongly suggested the presence of mitral valvular disease. The conclusion seems justified, therefore, that the right anterior oblique view with the patient recumbent will furnish earlier evidence of left atrial enlargement than the conventional criteria, as straightening of the upper left heart border, retrodisplacement of the barium-filled esophagus in the erect position, elevation of the main left bronchus, etc.

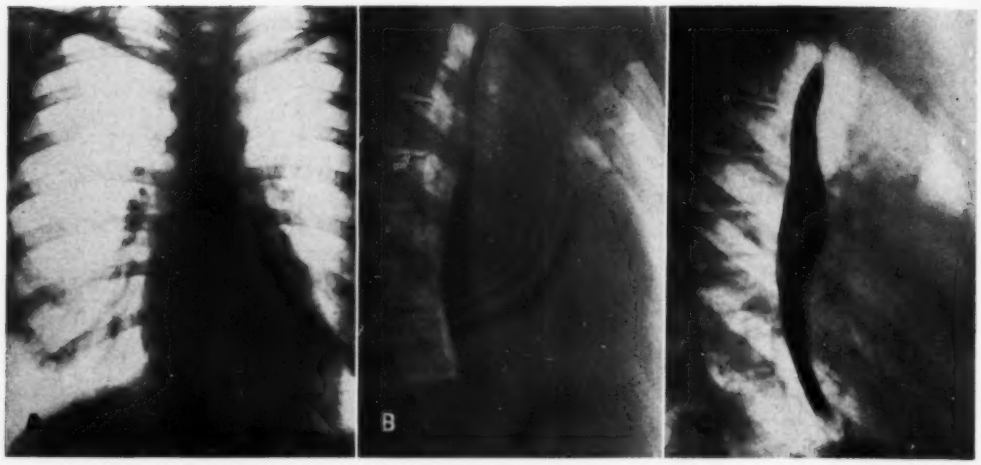

Fig. 6. F. B., female aged 24 years, with a rheumatic history. Clinical diagnosis: Mitral stenosis and aortic insufficiency. A. Postero-anterior roentgenogram, showing straightening of the left heart border, double contour of the right heart border, and cardiac enlargement to the left. B. Right anterior oblique erect esophagogram, showing a double line only. C. Right anterior oblique recumbent esophagogram showing definite localized retrodisplacement.

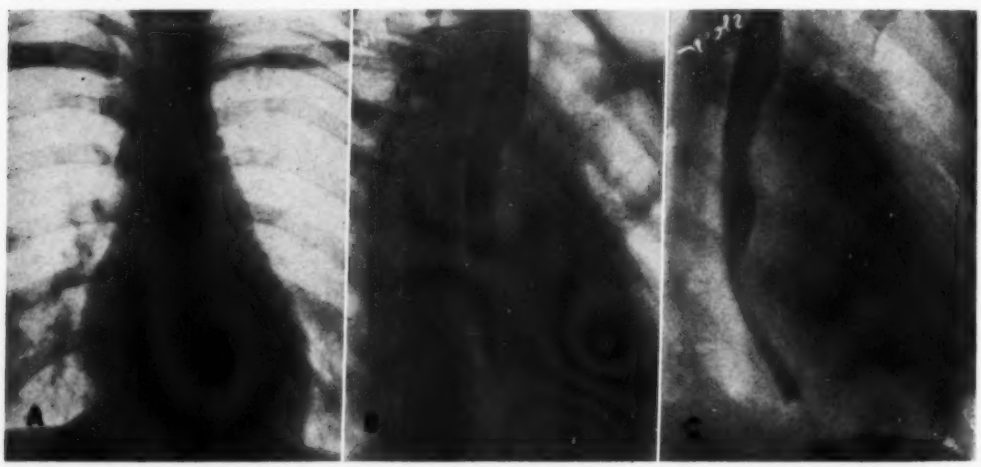

Fig. 7. I. S., female aged 19 years, with no heart complaints. Clinical diagnosis: Mitral stenosis. A. Postero-anterior roentgenogram, showing straightening of left cardiac border. B. Right anterior oblique esophagogram, showing slight retrodisplacement of the esophagus. C. Right anterior oblique recumbent esophagogram, showing marked retrodisplacement.

As to the explanation of the greater degree of encroachment upon the barium-filled esophageal line in the recumbent than in the erect position, two mechanisms, we believe, are operative. As previously suggested, atrial filling produced by the venous return is augmented with the patient in the recumbent position; secondly, the heart, thus filled to a larger extent, is brought closer to the esophagus by its own weight.

The value of this finding in clinical roentgenology is evident, since the demonstration of left atrial enlargement is the key to x-ray diagnosis of mitral valvular disease in the great majority of cases. Conventional methods of visualizing this enlargement seem to miss a fair number

of cases. Here, consequently, a method may become available for detecting such enlargement earlier than is currently being done by routine examinations. In cases where clinical or other roentgen evidence is inconclusive or doubtful, the recumbent right anterior oblique esophagogram may well decide the issue.

SUMMARY AND CONCLUSIONS

1. The demonstration of a localized indentation of the barium-filled esophagus at the proper level in the recumbent right anterior oblique position is an early, possibly the earliest, x-ray sign of left atrial enlargement.

2. Evidence furnished by the recumbent esophagogram precedes other x-ray changes of left atrial enlargement, such as straightening of the left upper heart border, retrodisplacement of the esophageal line in the erect position, elevation of the main left bronchus, etc.

3. In the presence of a localized indentation of the barium-filled esophagus in the right anterior oblique recumbent position, organic heart disease has to be considered. A diagnosis of functional murmur may thus be ruled out, except in an occasional case of valvulitis, where left atrial enlargement is not present.

4. This method of examination alone may at times establish the diagnosis. Its main use, however, is as an adjunct in doubtful cases.

5. With recumbent esophagograms, discrepancies between clinical and x-ray detection of mitral stenosis at its very beginning may well be considerably reduced. In view of the satisfactory results, wider use of this method is advocated.

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SUMARIO

El Esofagograma en Decúbito: Método Roentgenológico para el Descubrimiento Temprano de la Hipertrofia de la Aurícula Izquierda

La observación de un desplazamiento posterior localizado del esófago lleno de bario en la vista oblicua anterior derecha mientras el enfermo se halla recostado constituye un importante signo de hipertrofia de la aurícula izquierda, aportando datos más tempranos y notables del estado mencionado que los esofagogramas tomados con el enfermo puesto de pie. Además, dicho signo puede ser observado antes que pautas convencionales de la hipertrofia de la aurícula izquierda tales como el enderezamiento del borde izquierdo superior del corazón y la elevación del principal bronquio izquierdo.

Como la hipertrofia de la aurícula izquierda es hallazgo casi constante en la insuficiencia mitral, su presencia es muy indicativa de lesión cardíaca orgánica. Cabe así excluir el diagnóstico de soplo funcional salvo en alguno que otro caso de valvulitis en que no existe la hipertrofia mencionada.

A veces basta con este método de examen para establecer el diagnóstico. Sin embargo, su gran aplicación es como coadyuvante en la justipreciación radiológica y clínica de los casos dudosos.

Con los esofagogramas en decúbito, pueden fácilmente reducirse en forma considerable las discrepancias entre el descubrimiento clínico y roentgenológico de la estenosis mitral. Tan satisfactorios han sido los resultados obtenidos con dicho método de examen que se recomienda su empleo en mayor escala.

Perforation of Duodenal Ulcer During Fluoroscopy

Disposition of Barium Sulfate in the Abdominal Cavity[1]

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CASE REPORT

A WHITE FEMALE of 56 years, a college teacher of French, first experienced gastro-intestinal symptoms following harrowing experiences as an ambulance driver in France during World War I. In subsequent years she attributed her occasional bouts of epigastric distress to the gallbladder. Other relevant points in the history include appendectomy in 1911 and salpingo-oophorectomy in 1925.

Two weeks prior to the occurrence of perforation as reported here, the patient contracted an acute nonspecific upper respiratory infection. One week before perforation, pain recurred in the epigastrium and right hypochondrium, and she was referred by her physician for cholecystography. By the oral method normal cholecystograms were obtained. During the next few days pain gradually increased. A gastro-intestinal study, with barium sulfate, was begun on April 9, 1946, one week after recurrence of upper abdominal distress.

Fluoroscopy revealed a characteristically deformed, tender duodenal bulb which was being gently compressed when the patient suddenly screamed, complaining of inability to breathe and of severe upper abdominal pain radiating to the right shoulder. Since further fluoroscopy was impractical, serial films were quickly exposed. These demonstrated clearly the presence of barium in the peritoneal cavity in the vicinity of the first and second portions of the duodenum (Fig. 1).

Surgical consultation was promptly obtained, and immediate laparotomy was advised. This was stubbornly refused for eight and one-half hours.

The following notes are abstracted from the operative record:

"On opening the peritoneum, there was a gush of dish-watery fluid containing flecks of barium. Many adhesions were present between the lower edge of the liver, omentum, stomach, and duodenum. After sufficient adhesions had been freed, the stomach was pulled up, with good exposure of the perforated ulcer 1/2 inch distal to the pyloric sphincter on the anterior duodenum. This measured about 1/8 by 1/4 inch, with the long axis parallel to the gut. The perforation was closed with three sutures of fine catgut on an atraumatic needle plus four sutures in the long axis of the gut. An omental tab was tacked over the suture line. Aspiration was carefully done; several patches of barium were left behind adherent to the tissues, it being impossible to wipe them off with any degree of safety. After some debate, it was decided to close without drainage."

Fig. 1. Film exposed immediately following perforation, April 9, 1946, showing barium streaking of peritoneum in vicinity of first and second portions of duodenum.

The patient left the operating room in good condition; her postoperative course was uneventful, and she was discharged, cured, on the sixteenth postoperative day.

Opinions vary widely regarding the frequency of perforation during or shortly after roentgen study and the possible causal relation of the latter. In the German literature Himmelmann, Paas, and Panek, quoted by Gross (1), stress the relationship between roentgen examination and perforation. Himmelmann and Panek state that 29 and 22 per cent, respectively, of perforated peptic ulcers seen by them followed fluoroscopy with the

[1] Accepted for publication in January 1951.

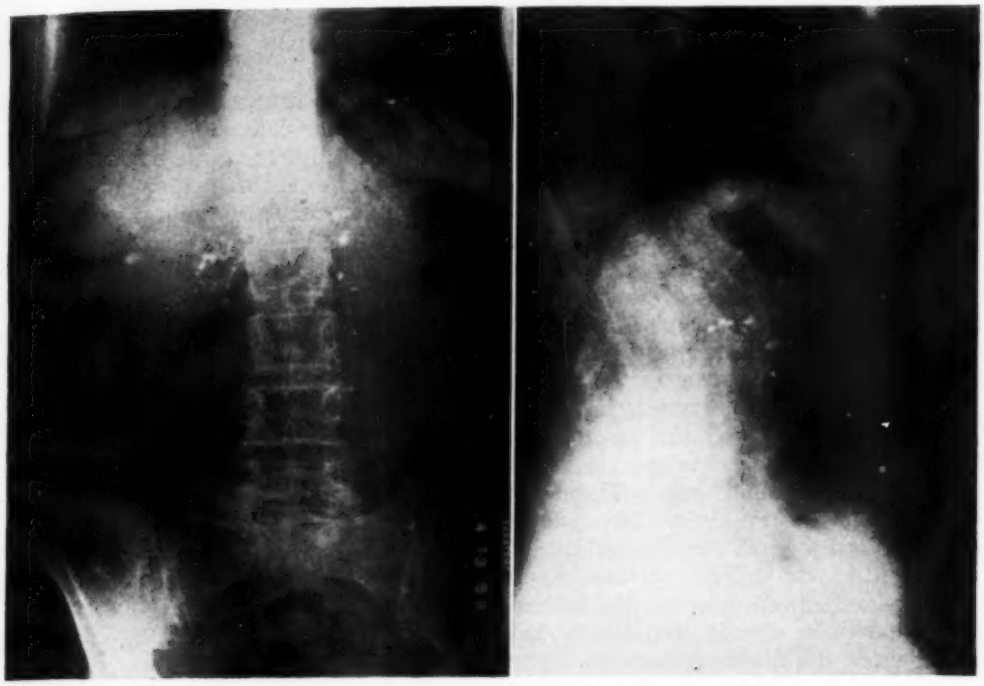

Fig. 2. Postero-anterior and lateral films of the abdomen made four years after perforation, April 13, 1950, showing barium in the upper and mid-abdomen. Note that none has descended into the pelvis.

barium meal. American observers report a much lower incidence, generally less than 1 per cent. Singer, among 500 cases of ruptured peptic ulcer at Cook County Hospital, Chicago, found only 4 in which a possible causal relation existed between roentgen study and perforation, an incidence of 0.8 per cent. Eckman of Duluth, Minn., found 5 cases among 500 of ruptured peptic ulcer in which roentgen study was followed shortly by perforation, an incidence of 1 per cent. It may be that heavy palpation during fluoroscopy as described in the German literature contributes to this discrepancy.

While numerous references in both English and German literature deal with acute perforation, few describe the actual occurrence of rupture during fluoroscopic observation. Of the large number of cases reported as acute rupture, practically all followed barium contrast study by a matter of hours or days. Very few have been seen to occur under the fluoroscope. Gross (1) reported one case which perforated during fluoroscopy, with operation one hour later, and a second of rupture an hour and a half after fluoroscopic examination. He raises the question of what should be done with the barium. He concludes from his study of 388 cases of perforated ulcer that in only 10 (2.6 per cent) did there exist reasonable suspicion of a causal connection with roentgen study. Schilling (2) reported one case of peptic ulcer seen to perforate under the fluoroscope, with operation three hours later.

Stimulated by Schilling's case report with eight months follow-up to determine the fate of barium with'n the peritoneum, I re-examined my patient on April 13, 1950. She is now in good health and active, teaching a full schedule; last summer she enjoyed a trip through Spain. The films (Fig. 2) show that the barium remained in the upper and mid-abdomen; the lower abdomen and pelvis are clear. The amount of barium and its distribution

support the observations of others: first, that barium in the peritoneal cavity quickly becomes fixed by fibrinous exudate; second, that there is a protective mechanism—pylorospasm—associated with acute perforation of duodenal ulcer which limits spillage and makes for better prognosis. In this case eight and a half hours elapsed between rupture and operation, yet little increase in the quantity of barium in the peritoneal cavity appears to have occurred. Paas found in experiments on dogs that pylorospasm occurs promptly and lasts about five hours after perforation of duodenal ulcer. This results in diminished contamination of the peritoneum following rupture of duodenal ulcer as compared to the rapid gross soiling after perforation of gastric ulcer. The numerous adhesions support the observations of Schilling. In his patient, operated upon three hours following rupture, the barium was found to be already mixed with and agglutinated by fibrinous exudate. The end-result in these two cases seems to justify the opinion that barium in the peritoneal cavity may be left alone with safety.

In 1942, Ulfelder and Allen (3) reported their studies of 334 cases of acute perforations of the stomach and duodenum at the Massachusetts General Hospital between 1916 and 1940. They noted, among other things, a striking parallelism between virulence of respiratory tract infections prevalent in the community and the mortality from ruptured peptic ulcer. In the case reported here, although not fatal, there was an antecedent acute upper respiratory infection.

SUMMARY

A case of duodenal ulcer perforating during fluoroscopic study is reported, together with certain theoretical and practical considerations. Previously Schilling collected 57 cases from the literature and added the 58th. Gross reported the 59th. The case reported here is believed to represent the 60th.

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SUMARIO

Perforación de Ulcera Duodenal Durante la Roentgenoscopia. Radicación del Sulfato de Bario en la Cavidad Abdominal

El caso comunicado aquí es de úlcera duodenal perforada durante un examen roentgenoscópico, creyéndose que es el sexagésimo caso descrito de perforación observada durante la fluoroscopia o inmediatamente después. El enfermo fué operado a las ocho horas y media de sobrevenir la rotura y se repuso por completo. Las radiografías tomadas inmediatamente después del episodio, antes de la operación, revelaron claramente la presencia de bario en la cavidad peritoneal en la vecindad de la primera y la segunda porciones del duodeno. El examen roentgenológico reveló cuatro años después que el bario estaba todavía limitado a las porciones superior y media del abdomen.

Las observaciones realizadas en este caso apoyan las de otros autores: (1) que el bario en la cavidad peritoneal es fijado prontamente por exudado fibrinoso; y (2) que, con la perforación de una úlcera duodenal, se asocia un mecanismo protector, en forma de piloroespasmo, que limita el esparcimiento y contribuye a mejorar el pronóstico.

Importance of the Relation Between the Anthropometric Index and the Transverse Cardiac Diameter for Appraising the Size of the Heart[1]

PROF. GONZALO ESGUERRA GÓMEZ

Bogotá, Colombia, S. A.

BOGOTÁ, THE CAPITAL of the Republic of Colombia, is situated at an altitude of 8,660 feet above sea level. This fact offered the opportunity to ascertain whether cardiac hypertrophy exists in normal persons living on the plateau. In roentgenologic studies carried out by Kerwin (1), in Oroya, Peru, 11,930 feet above sea level, an increase of 11.5 per cent above normal standards was found in the heart size of the natives, and in x-ray studies carried out by Miranda and Rotta (2), at Morococha, Peru, situated at 13,840 feet, an increase of 21 per cent in the cardiac size of the inhabitants was established.

Undoubtedly radiologic research has made possible more exact results in cardiac mensuration by the use of the orthodiagram or by teleroentgenography, since both procedures permit estimation of the real size of the heart image without any major error. I have, however, abstained from the use of the orthodiagram because this test involves subjective appreciation of the results without providing an impersonal graphic documentary record.

Since in roentgenograms exposed at a distance of 6 to 6 1/2 feet the size of the cardiac shadow does not exceed the actual diameter by more than 5 per cent (3), it may be assumed that the teleroentgenogram gives us the real size of the heart of the person under examination. Though the variations of size observed between diastole and systole may produce variations in the transverse diameter by 1.5 to 2.0 cm., it has been found that in the majority of teleroentgenograms made at the moment of moderate inhalation no appreciable differences exist between the various test individuals because, as a rule, it happens that the heart film is obtained in the moment of diastole, which is the longest (3). I have refrained from estimating the heart area and the oblique and longitudinal diameters of the heart because, in order to obtain these measurements, it is necessary to determine by fluoroscopy the points at the right and left where the cardiac curve ends and the vascular curve begins, and this is subject to appreciable individual variations.

It is for these reasons that a study was undertaken of the significance of transverse cardiac diameter, not, however, as an isolated measurement, but in relation to the weight and height of the persons examined.

The little credit vouchsafed by clinicians and radiologists to radiographic measurements of the heart is due not to lack of mathematical precision but to the great individual variations found. These individual variations make it difficult to establish in a given case the exact limit of the normal. To give these measurements some value, it is necessary to relate them to the area to which the heart must supply blood in each particular instance, and this is accomplished by taking into consideration the weight and height of the subject. To this end, it is sufficient to measure the total transverse cardiac diameter and to compare it with the anthropometric index, since it has been proved that the variations in area and volume of the heart follow the same proportions as the transverse diameter.

The biologic constant established by Ungerleider and Clark (4) is based on the

[1] Read before the Third Inter-American Congress of Radiology, Santiago, Chile, November 1949. Accepted for publication in September 1950.

above considerations and has therefore been applied in the present study. This constant, in which the weight and height of the person examined are appraised in pounds and inches, is expressed as follows:

$$\frac{Weight\ (lb.) \times 100{,}000}{Height\ (in.) \times (trans.\ diameter)^2} = 13.83$$

As the prediction charts of Ungerleider and Clark were based on the weight and height in pounds and inches, I began by transforming this constant into another with the weight and height in kilos and centimeters, with which I made a new set of prediction charts. The new constant is as follows:

$$\frac{Weight\ (kg.) \times 100{,}000}{Height\ (cm.) \times (trans.\ diameter)^2} = 2.47$$

Two prediction charts were made. In the first, the weight, height, and prediction for adults are found, and in the second, the corresponding values for children and adolescents. The results of this research, presented in Atlantic City on the occasion of the Centenary of the American Medical Association (5), may be summarized as follows:

From a study of the transverse diameter of the heart in teleroentgenograms of 480 normal persons living in Bogotá, it was concluded that the values of these diameters in relation to the weight and height of the persons examined corresponded exactly with those obtained by Ungerleider and Clark in persons living at sea level. These results were corroborated by the corresponding Gauss curve, and were in accord also with the absence of electrocardiographic signs of cardiac hypertrophy (6 and 7), and with the normal arterial tension, pulse, respiratory rate, respiratory capacity (8), and the number of red blood corpuscles among the inhabitants of Bogotá.

It was an impressive observation, also, that when the transverse diameters, the weights, and the heights of the persons examined were added and the corresponding averages were taken, the same coefficient was obtained by the formula described that had emerged in studies of persons living at sea level.

The similarity of the results obtained—starting out with very different transverse diameters, weights, and heights—made the correctness of the aforementioned constant quite evident, and emphasized the importance of relating the transverse cardiac diameter to the anthropometric index in estimating the heart size.

It occurred to me that a similar relation between the transverse diameter of the heart and the anthropometric index was possible in children and adolescents, and because of this a prediction chart was constructed for children. As the number of children examined by me was insufficient to obtain reliable data and, on the other hand, since no research worker had made similar studies, perhaps because any such relation among children had not been presumed, I utilized the important work carried out by Dr. Marion Maresh (9), who kindly placed at my disposal all the histories related to her investigation. In Dr. Maresh's study a group of 128 boys and girls were examined radiologically several times a year over a period of more than twenty years. Though the purpose was to study the growth of the heart in relation to body growth through childhood and adolescence, the fact that the transverse diameter of the heart was measured in roentgenograms at a 6-foot distance, and the added fact, no less important, that weight and height were measured in kilos and centimeters, enabled me to use the prediction charts and to approach the problem from another point of view, since Dr. Maresh did not attach any major value to the anthropometric index in relation to the transverse diameter of the heart.

Of a total of 3,205 roentgenograms of the 128 children (71 boys and 57 girls), only 3,190 gave the three necessary data (transverse diameter of the heart, weight, and height), and I shall therefore refer exclusively to this number. The details involved in this research have been described in a special article presented before the Academia de Medicina de Colombia

(10) and I shall therefore limit myself here to a brief presentation.

I first added the weights, heights, and transverse cardiac diameters as determined in the 3,190 observations and divided the totals by this number in order to obtain an average. Corresponding to the averages of weight and height, the transverse diameter should be, when based on the prediction charts, 99 mm. The actual figure obtained was 92.6 mm., representing a deviation of less than 6 per cent.

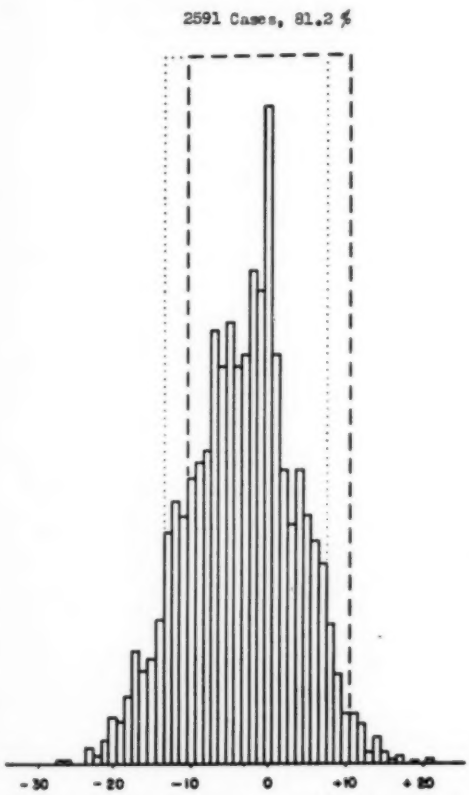


Fig. 1. Histogram based on 3,190 observations; 2,591 (81.2 per cent) fall between plus and minus 10 per cent; 599 (18.8 per cent) are above or below the average (16.86 per cent below and 1.94 per cent above).

As the data appeared to warrant a continuation of the study, I went on by recording in each of the 3,190 cases the percentage of deviation of the transverse cardiac diameter from the prediction charts.

TABLE I: ANTHROPOMETRIC INDICES AND CORRESPONDING AVERAGE TRANSVERSE DIAMETERS

Anthropometric Indices	Number of Cases	Average Diameter
13.64	42	7.50
14.65	48	7.86
15.55	114	7.96
16.50	210	8.16
17.49	287	8.35
18.50	272	8.54
19.48	216	8.72
20.49	241	8.82
21.49	219	8.98
22.49	193	9.23
23.52	161	9.29
24.54	139	9.51
25.55	145	9.55
26.51	118	9.79
27.44	111	9.80
28.50	83	9.98
29.58	79	10.12
30.40	84	10.28
31.49	80	10.35
32.54	66	10.66
33.60	60	10.72
34.47	52	11.04
35.50	37	11.73

With these data I constructed a histogram of the 3,190 cases (1,827 boys and 1,363 girls), in which the zero point predominates, though there is a slight deviation of less than 3 per cent (Fig. 1).

In corroboration I obtained the anthropometric index for each of the 3,190 observations. These indices were then arranged in groups (from 13 to 35), as were the corresponding transverse diameters, and an average was obtained by dividing the sum of the diameters and the indices by the number of cases (Table I).

With the results thus obtained I constructed a graph in which the averages of the transverse diameters were indicated by crosses in front of each index. With the value of the constant, I then computed the theoretical transverse diameter of each one of the indices, marking it on the graph by a series of dots which were joined by a line (Fig. 2).

As the graph showed that negative deviations appeared only in the anthropometric indices of the larger children, another histogram was constructed on the basis of observations made between the ages of four and eight years. This new histogram is exactly similar to the one for adults. Its center coincides with the zero

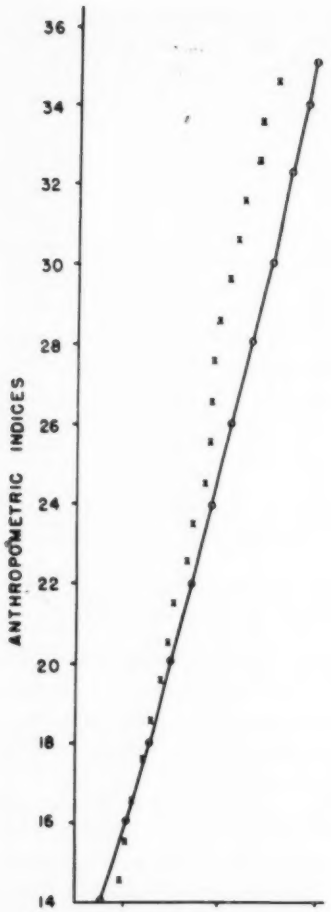


Fig. 2. Graph showing the constant (solid line) and the average corresponding to the transverse diameter of each index (indicated by a cross).

point, there is no deviation at all, and 88.53 per cent of the cases are included among the plus or minus 10 per cent (Fig. 3).

Both the graphs and the histograms agree as to the results. From four to eight years there is complete agreement between what was found and the prediction charts based on the anthropometric index as it is found with adults. From nine to sixteen years there is a slight deviation (−3 per cent) which is not sufficient to change the prediction charts, because more than 80 per cent of the cases are grouped around the central zone of the histogram and because there is a notable predominance of the zero point.

It is, however, necessary to find an explanation for this slight deviation.

The work of Stuart and Hill (11) and that of Stuart and Sobel (12) show that the subcutaneous tissue increases rapidly until nine months of age, that it then decreases rapidly and abruptly until two and a half years, and more slowly until five and a half years. Between five and a half

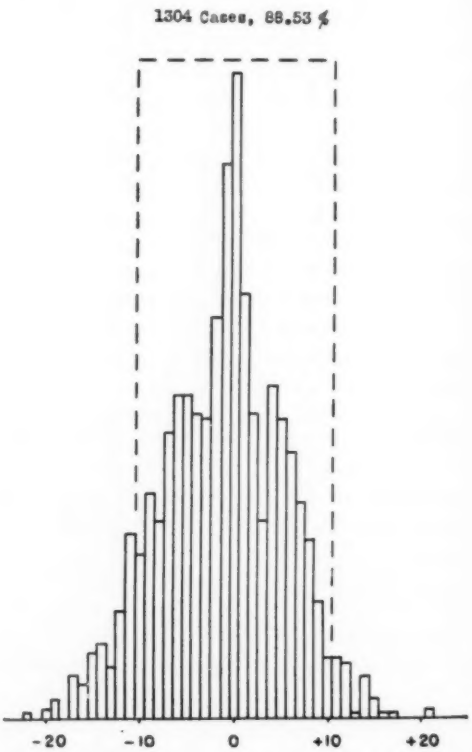


Fig. 3. Histogram based on 1,473 observations (809 in boys and 664 in girls) on children between three and eight years of age; 1,304 (88.53 per cent) are between plus and minus 10 per cent, with only 169 (11.47 per cent) above or below the average (2.92 per cent above and 8.55 per cent below).

and eleven years no variation can be noticed, but from eleven to thirteen years there is a new definite increase which seems to coincide with the beginning of an accumulation of fat in adolescence.

Having in mind the previous conclusions,

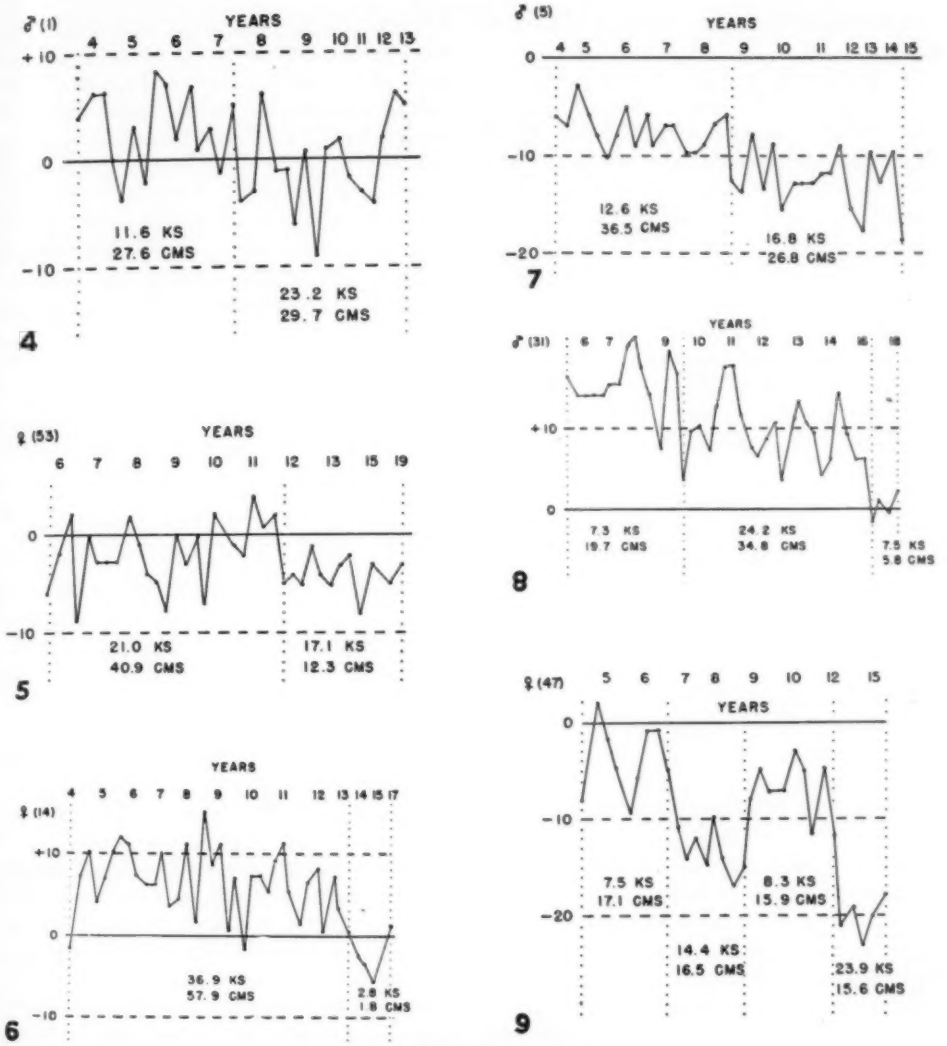


Fig. 4. Example of Group 1.
Fig. 5. Example of Group 2.
Fig. 6. Example of Group 3.
Fig. 7. Example of Group 4.
Fig. 8. Example of Group 5.
Fig. 9. Special case showing frank deviation toward negative values, as compared to predictions, with rapid increase in weight.

it is strange that no change in the relation between the transverse cardiac diameter and the anthropometric index was found between four and eight years, but that there was a slight negative variation between nine and sixteen years. And if such cases are studied separately, it is striking that the negative variations coincide, generally, with an abrupt increase in weight in relation to growth.

Such an individual study allows, furthermore, classification of the observations into five different groups and the construction of graphs showing the percentage of the deviation of the transverse diameter of each child at different ages above or below

a horizontal line which represents the zero point.

The first three groups are represented by those children in whom, during almost their whole development, the cardiac transverse diameter fell in the central part of the histogram, that is, between plus and minus 10 per cent. The first group (Fig. 4) hovers around the zero point, sometimes with positive and at other times with negative oscillations. The second group (Fig. 5) also represents oscillations in both directions but on the whole negative values are predominant. The third group (Fig. 6) is similar to the second, but with a predominance of oscillations in a positive direction.

The last two groups, which are less numerous, represent cases which often deviate beyond the plus or minus 10 per cent level. In the fourth group (Fig. 7) the negative deviations are conspicuous; and in the fifth the positive ones are emphasized (Fig. 8).

In the examples of each of these groups it can be clearly appreciated that the marked negative deviations invariably coincide with an evident increase in weight and that the positive deviations show a predominance of growth in relation to weight. In the case of Figure 9, which corresponds to the fourth group, that is, the one which frankly deviates toward negative values, the relation between the abrupt increases in weight and the negative values can well be appreciated, thanks to the fact that the fluctuations are very marked and variable. In this graph it can be seen that from twelve to sixteen years, the period in which the negative variations are very pronounced, there is an increase in weight of 23.9 kilos during a growth of 15.6 centimeters. On the other hand, between four and a half and six and a half years, an age where the values are close to the zero point, the increase in weight is only 7.5 kilos during a growth of 17.1 centimeters, that is to say, it is only a third of that in the other period.

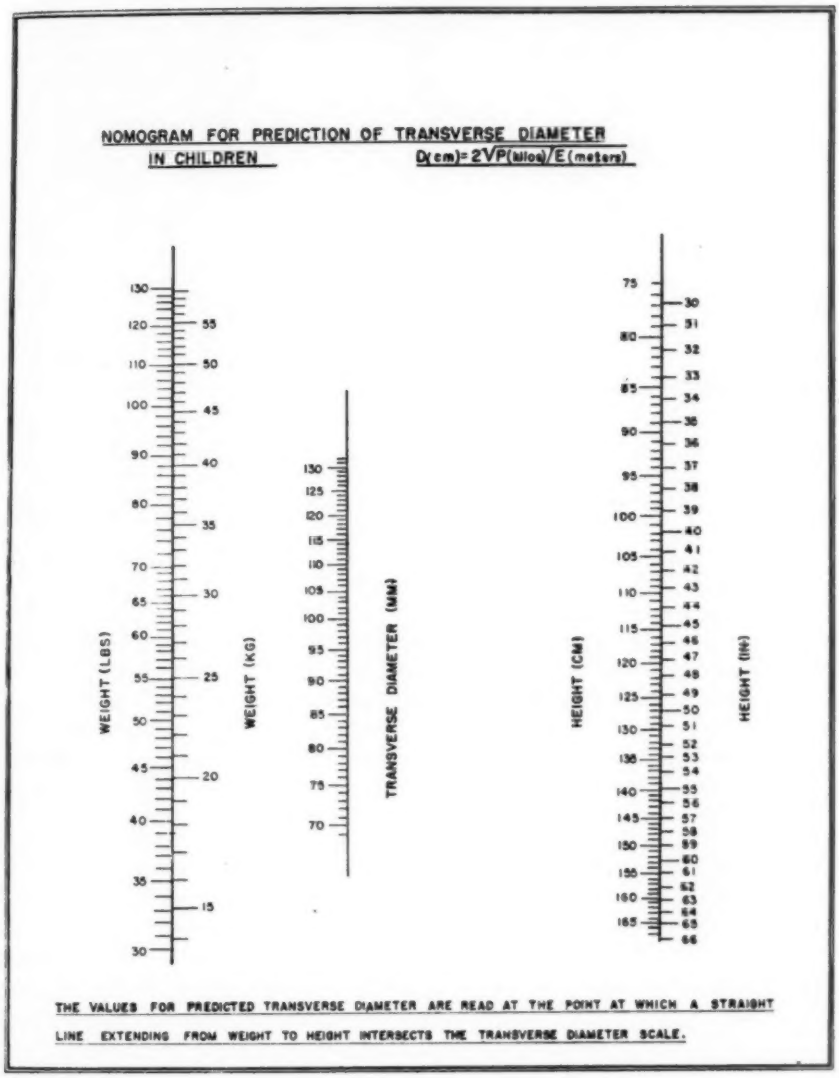
Now, if in the case of a certain child we ascertain the diameter that corresponds to his anthropometric index, and if this child at a given period of his growth accumulates an excessive amount of fat in the subcutaneous cellular tissue, there is no reason why the heart, an essentially muscular organ, should grow in proportion with the increase in weight. Therefore his transverse diameter as shown in the chart will appear smaller when compared with the weight and height as actually found on examination, producing thus a negative deviation.

The previous considerations have led me to believe that the accumulation of excessive fat during certain periods can explain the small negative deviation of the transverse diameter of the heart from nine to sixteen years. In the same way, a rapid loss in weight may and must produce a marked positive deviation. It is enough to quote the example of healthy persons showing a normal relation between the transverse cardiac diameter and the anthropometric index who, due to a sudden loss in weight through a serious illness, show a positive deviation in that relation without indicating as its cause a cardiac hypertrophy.

Summing up what has been said, it may be stated that the measurement of the transverse diameter of the heart in teleroentgenograms made at a distance of 1.80 meters, and in moderate inspiration, permits an estimate of the size of the heart both in children and in adolescents as well as in adults, provided this measurement is compared with the anthropometric index. It must be noted that an abrupt and excessive fattening or loss in weight produces marked negative or positive deviations which do not imply any pathologic variation in the heart size.

The relation between the transverse cardiac diameter and the anthropometric index is established by means of prediction charts or nomograms (see p. 223) worked out on the constants that have been pointed out. The centesimal deviation of each case must be carried out arithmetically or with the aid of a chart prepared beforehand.

The fact that prediction charts have to


NOMOGRAM FOR PREDICTION OF TRANSVERSE DIAMETER IN CHILDREN
D(cm)=2√P(kilos)/E(meters)
WEIGHT (LBS)
WEIGHT (KG)
TRANSVERSE DIAMETER (MM)
HEIGHT (CM)
HEIGHT (IN)
THE VALUES FOR PREDICTED TRANSVERSE DIAMETER ARE READ AT THE POINT AT WHICH A STRAIGHT LINE EXTENDING FROM WEIGHT TO HEIGHT INTERSECTS THE TRANSVERSE DIAMETER SCALE.

be used doubtless reduces the simplicity of the procedure and restricts its use to a relatively small group of specialists in roentgen diagnosis. As it would be ideal to popularize the procedure so that it can be used by the majority of radiologists and also by general practitioners, it occurred to me that a slide rule based on the same constant might be the solution of the problem.

The result of the constant which utilizes the weights and heights in kilos and centimeters was 2.47. But as I sought for a simple formula I approximated the constant to 2.5, sure that there would not be any appreciable variation in the results. Thanks to this approximation I could transform the constant into the following:

$$2\sqrt{\frac{Weight\ (in\ kilos)}{Height\ (in\ meters)}} = Transverse\ diameter\ in\ centimeters$$

A comparative study between the re-

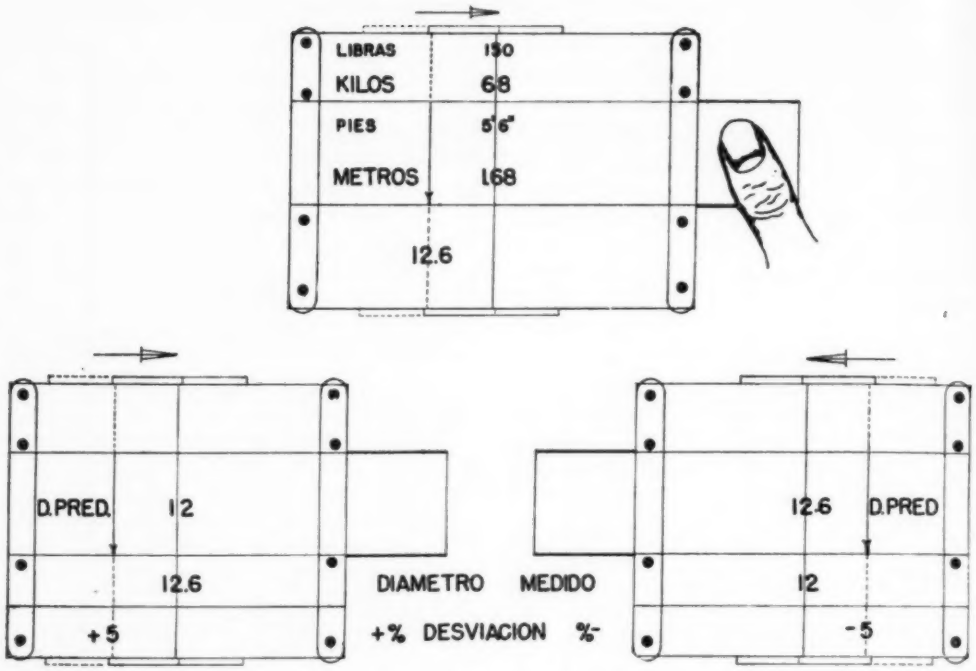


Fig. 10. Details of proposed slide rule.

sults obtained with the two figures showed a maximum variation of only 1.0 mm.

The simplified new formula has the advantage of giving as a result the transverse cardiac diameter simply by extracting the square root of the quotient of weight by height and multiplying by 2. But every ordinary slide rule extracts the square root of a quotient. It is thus enough to double the product obtained on the lower scale of one of these rules to get the transverse cardiac diameter of prediction. By the simple device of adding the equivalent in pounds and inches on top of the corresponding scales in kilos and meters, the rule can be used not only in the Latin countries but also in the English-speaking countries.

But there could be, still further, a small gadget on the slide rule that would show the percentage of deviation in each case examined. Thanks to the kind co-operation of my good friend, Capt. J. Ainlinger, an expert specializing in the construction of slide rules, another new scale could be added that allows one to find quite easily the percentages of deviation, both positive and negative.

Figure 10 shows a drawing of such a slide rule; and in Figure 11 an example is given that shows clearly how it might be used.

In conclusion, I would urge all radiologists, in their routine daily work, to increase the number of studies of the transverse cardiac diameter in relation to the anthropometric index, in order to test the truth of what I firmly believe, that this is the only simple radiologic procedure which, in accordance with biologic laws and constants, permits one to state, with rather precise norms, up to what point the heart of a person can be considered normal within the group of his equals and in accordance with the area which this organ must supply with blood.

SUMMARY

The little credit vouchsafed by clinicians and radiologists to radiographic measurements of the heart is not due to the lack of

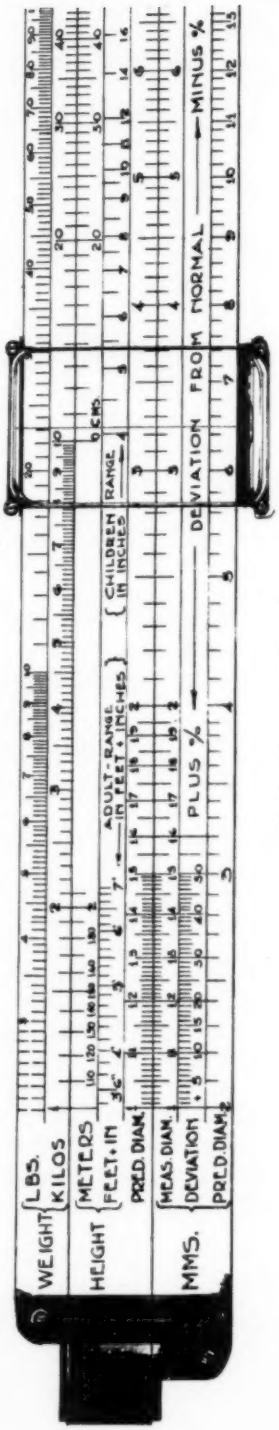


Fig. 11. Proposed slide rule.

mathematical precision but to the great individual variations found. These individual variations make it difficult to establish in each case the exact limit of the normal. To give these measurements a real value, it is necessary to relate them to the area to which the heart must supply blood in each particular case, and this is reached by taking into consideration the anthropometric index, that is to say the relationship between the weight and height of the person examined.

The procedure may be simplified by using only the relationship between the transverse diameter of the heart and the anthropometric index, as this relationship must be considered as a biologic constant. The work of Ungerleider and Clark, corroborated lately by the author, proved the existence of the said constant in adults. And its demonstration in childhood and adolescence has been made from data obtained from Dr. Marion Maresh. It is only necessary to recall that from nine to fifteen years there have been found slight negative variations that coincide with accumulation of fat in subcutaneous tissue during growth periods.

As the author reaches the conclusion that the transverse diameter of the heart is equal to twice the square root of weight divided by height $\left(D = 2\sqrt{\frac{W}{H}}\right)$, he advises the convenience of using a slide rule instead of prediction charts, taking into consideration that any slide rule permits one to obtain the square root of a quotient. Such a slide rule might carry scales making it applicable to the systems of measurements used in both Latin and English-speaking countries.

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SUMARIO

Importancia del Indice Antropométrico y del Diámetro Transverso del Corazón para la Determinación del Area Cardíaca

El autor considera que, aun cuando las medidas radiográficas del corazón tienen una exactitud casi matemática, el poco uso que de éllas hacen los clínicos y los radiólogos, se debe a las grandes variaciones individuales encontradas, las cuales hacen muy difícil establecer en cada caso el límite exacto de la normalidad. Para que estas medidas tengan valor se necesita relacionarlas con el área que tiene que irrigar el corazón en cada caso particular, lo cual se logra teniendo en cuenta el índice antropométrico, es decir la relación entre el peso y la estatura de los examinados.

Para simplificar el procedimiento aconseja relacionar únicamente el diámetro transverso cardíaco con el índice antropométrico, ya que a su modo de ver esta relación debe considerarse como una constante biológica. Los estudios de Ungerleider y Clark, corroborados posteriormente por el autor, comprueban la existencia de dicha constante en el adulto. Y su demostración en los niños y adolescentes pudo hacerla el autor con los datos suministrados por la Dra. Marion Maresh. Solo hay que señalar en estos últimos pequeñas desviaciones negativas de los 9 a los 15 años, las cuales se explican por la acumulación de grasa en el tejido celular subcutáneo durante algunos períodos del crecimiento.

Como el autor llega a la conclusión de que el diámetro transverso del corazón es igual a dos veces la raíz cuadrada del peso dividido por la estatura $\left((D = 2\sqrt{\frac{P}{E}}\right)$, insinúa la conveniencia de emplear una regla de cálculo en lugar de cuadros de predicción, teniendo en cuenta que toda regla de cálculo sirve para obtener la raíz cuadrada del producto de una división. Al mismo tiempo señala las modificaciones que se deben hacer en la construcción de la regla, para poder usarla con las unidades de medida empleadas tanto en los países latinos como en los sajones, y para obtener al mismo tiempo el percentaje de desviación centesimal.

Studies with Radioiodine[1]

II. Treatment of Patients with Hyperthyroidism by I^{131}

EARL R. MILLER, M.D., MORRIS E. DAILEY, M.D., MAYO H. SOLEY, M.D.,[2] NADINE FOREMAN, M.D., A. V. HOLMES, M.D., GEORGE L. ALEXANDER, M.D., and GLENN E. SHELINE, M.D.

THIS PAPER, FOLLOWING one on the Function and Rate of I^{131} Uptake of Thyroid[3] deals with the treatment of hyperthyroidism by that isotope. Its purpose is to present the method employed and the results obtained at the University of California School of Medicine. Certain concepts with regard to the place of I^{131} in the treatment of hyperthyroidism are included.

Interest in the therapeutic use of radioiodine in hyperthyroidism at the University of California began in 1938 with the studies of Dr. Joseph G. Hamilton and the late Dr. Mayo H. Soley. These studies were interrupted by the war and later resumed in the Radiology Division of the Medical School. In the early part of this work Dr. Soley and other members of the University of California Thyroid Clinic handled the clinical phases. Dr. Soley later left the University and Dr. Morris E. Dailey assumed the direction of the Thyroid Clinic. All the radiation aspects were handled in the Division of Radiology.

In 1946 studies on animals were carried out with particular reference to the destructive effect of radioiodine on the thyroid, its surrounding structures, the liver, and the kidneys. These studies encouraged us to believe that we could use radioiodine with relative safety in the treatment of patients with thyrotoxicosis.

PATIENTS TO WHOM I^{131} WAS GIVEN FOR HYPERTHYROIDISM

This report presents data on the first 100 consecutive patients to whom I^{131} was given for the treatment of hyperthyroidism after resumption of the work in 1945. Most of the patients came initially from the Thyroid Committee of the University of California School of Medicine, San Francisco. Many of the rest were sent to the Committee for clinical study.

In retrospect, it appears from a review of the records that all the patients had hyperthyroidism at the time they were treated. Patients with nodular goiters and those who were known to be pregnant were not accepted for treatment.

The diagnosis of hyperthyroidism was made by evaluation of the clinical status and the laboratory findings. Hyperthyroidism can be diagnosed only on clinical grounds. Laboratory data are helpful, but in themselves never establish the diagnosis. In taking the history of the patient all points were considered, but particular attention was paid to those which could be quantitated, such as increase in food intake, loss of weight, increase in frequency of stools, decrease in length of menstrual periods, and decrease in number of blankets used at night. Less emphasis was placed on such subjective symptoms as palpitation, nervousness, and irritability. In the frequent and difficult problem of differentiation between mild hyperthyroidism and the anxiety state, considerable weight was given to the constancy or accentuation of the symptoms from the time of their onset.

In the physical examination all findings were considered. A constant elevation of

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[1] From the University of California School of Medicine, San Francisco 22, Calif. Accepted for publication in December 1950. Presented (in part) at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

This work was started under contract No. W-7405-eng-48-C and continued under contract AT-11-1-GEN-10, Project No. 2, both being contracts of the University of California with the United States Atomic Energy Commission. The work was supported in part by these contracts and in part by the University of California.

[2] Deceased.

[3] Radiology **57:** 37–46, July 1951.

the truly basal pulse rate was a requisite to the diagnosis.

A diagnosis of hyperthyroidism was not made when there was a real question of its presence. In such questionable cases the patient was followed without treatment until the disease was found to be unequivocally present or absent.

METHOD OF TREATMENT BY I^{131}

In the early work, repeated small doses, approximately 250 microcuries at weekly intervals, were used for the treatment of thyrotoxicosis. These doses were employed because of insufficient knowledge of the amount of the isotope required to control the disease without danger, and because the radioiodine supply was limited. As our information and confidence grew, the doses were increased considerably in size. At first it was hoped that the dose might be more directly related to the severity of hyperthyroidism than to the size of the thyroid gland, as this would have obviated the difficulty of estimating the size of the thyroid, but this did not prove to be the case. Since the middle of 1947, attempts have been made to calculate the doses in radiation units, taking account of thyroid size and data from the I^{131} uptake curves. An effort was made to give to all patients an initial dose of 6,000 beta rep.

As the first step in treatment a test dose of I^{131}, usually 100 microcuries, was administered orally to the fasting patient. The uptake in the thyroid was determined at about one, three, and six hours after administration and daily for at least four more days. The uptake curve was then drawn. From the estimated thyroid weight and the uptake curve for the test dose, the amount of I^{131} necessary to deliver 6,000 beta roentgen equivalents to the thyroid was calculated according to the method of Marinelli. This amount was given as an oral therapy dose and its uptake by the thyroid measured in a manner similar to that for the test dose. Since the uptake curve for the therapy dose varied somewhat from the one obtained for the test dose, the amount of radiation to the thyroid was then recalculated. Thereafter, whenever possible, the patient was examined at weekly intervals. Basal metabolic rate and serum protein-bound iodine tests were done occasionally during the initial follow-up period. About six weeks following the initial treatment dose, the patient was re-examined, an uptake curve was obtained following a test dose of I^{131}, and retreatment was given if necessary. Estimation of the number of beta roentgen equivalents to be delivered to the thyroid by such a retreatment dose was based on the response obtained from the earlier therapeutic dose and on the clinical state of the patient. If retreatment was given, the uptake curve for this dose was also determined. About twelve weeks after the initial therapy dose, an uptake curve was again obtained, and treatment given as indicated. When the patient reached a state of clinical remission, follow-up visits were spaced at longer intervals. An attempt was made to follow the patients continuously from the time of their first treatment.

In most cases more than one dose of I^{131} was given. It was intended that the first dose would be of such size that the patient would be improved by it but not "cured." This provided a gauge by which the amount that might be necessary to finish treatment could be estimated. In approaching the treatment of the syndrome of hyperthyroidism in this way, it was our hope that we could "cure" patients without producing hypothyroidism. It is obvious that we were not successful in all cases. We are, however, sufficiently satisfied with this approach that we intend to continue it.

OBSERVATIONS AND RESULTS

Between September 1945 and July 1949, 100 patients received I^{131} for treatment of hyperthyroidism. The data were analyzed as of January 1951. Figure 1 is designed to show primarily the time of beginning treatment, the length of illness after beginning treatment, and the length of follow-up. The heavy black lines indicate the times during which the patients remained sick,

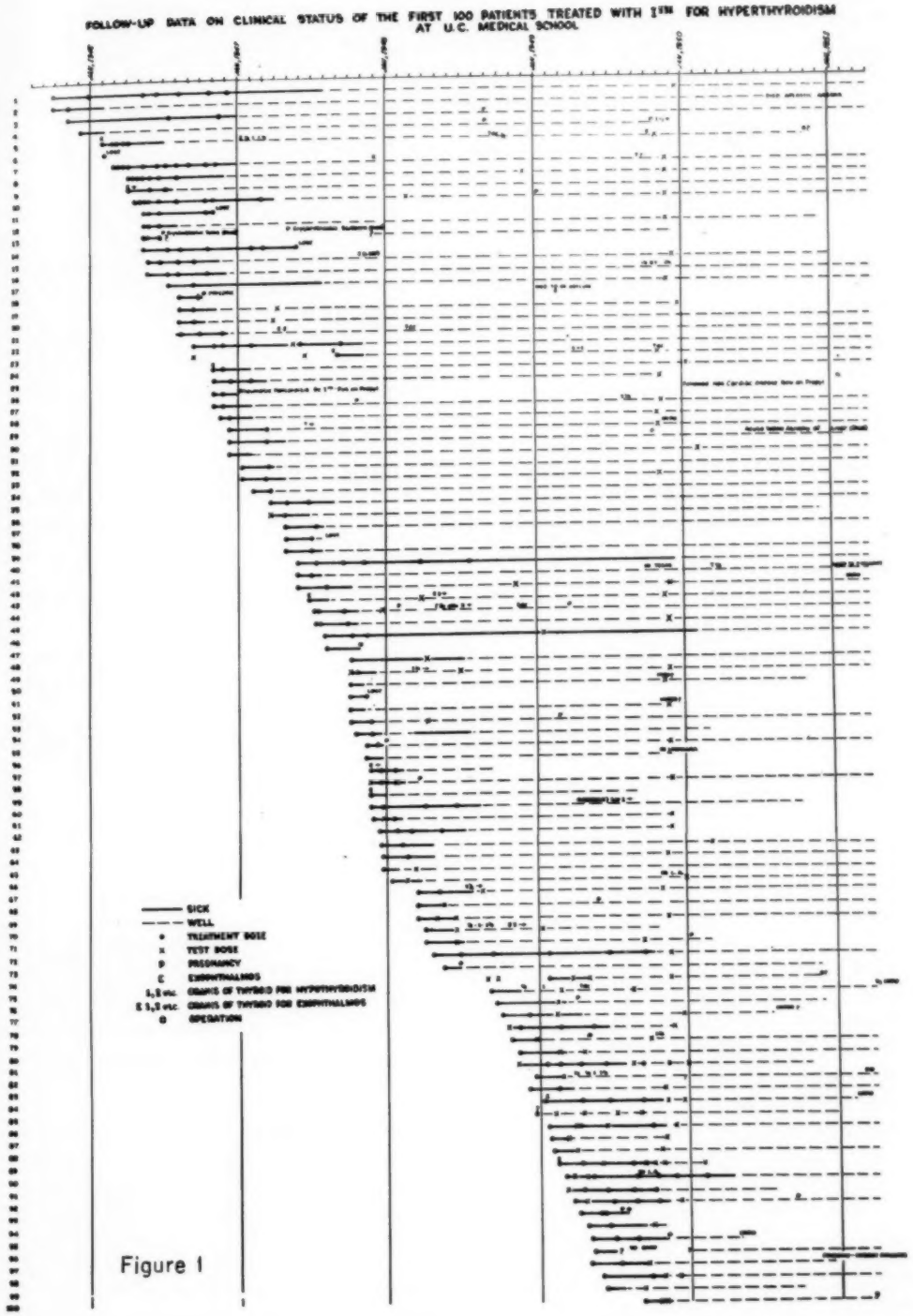
FOLLOW-UP DATA ON CLINICAL STATUS OF THE FIRST 100 PATIENTS TREATED WITH I¹³¹ FOR HYPERTHYROIDISM AT U.C. MEDICAL SCHOOL
SICK
WELL
TREATMENT DOSE
TEST DOSE
P PREGNANCY
E EXOPHTHALMOS
S OBVIOUS OF THYROID FOR HYPOTHYROIDISM
S OBVIOUS OF THYROID FOR EXOPHTHALMOS
O OPERATION

Figure 1

the broken lines indicate the times when the patients were considered well, and the black dots indicate the times of treatment. On the original chart one can also see the times of test doses, times of pregnancies, presence of exophthalmos, times of taking thyroid by mouth, and some general comments. These are difficult to detect in the reproduction.

Among these 100 patients were 13 men and 87 women. The age distribution was as follows (the age of one of the patients is unknown):

Age	*Number*	*Age*	*Number*
0–5	1	36–40	12
6–10	4	41–45	11
11–15	3	46–50	12
16–20	8	51–55	6
21–25	8	56–60	7
26–30	14	61–65	1
31–35	9	Over 65	3

Forty-nine patients had one or more kinds of treatment directed toward the thyroid from one month to several years before receiving I^{131}.

Operation	12
Lugol's solution	29
Propylthiouracil	11
Thiouracil	7
X-ray	3
Thyroid by mouth	9

Although it is difficult to assess the degree of severity of hyperthyroidism, an estimate was made with the following results: mild 23; moderate 48; severe 25; undecided 4.

The oral doses of I^{131} given to these patients are shown in Table I. No conclusions can be drawn from these data, however, about the amount of radiation to the thyroid, since the dose of I^{131} given by mouth does not necessarily parallel the radiation dose to the thyroid. Because adequate uptake data for the earlier patients were not available, the radiation doses for those patients could not be calculated.

TABLE I: ORAL DOSES OF I^{131}

Millicuries	*Number of Patients*
0– 1.9	5
2– 3.9	21
4– 5.9	18
6– 7.9	18
8– 9.9	11
10–11.9	8
12–18.9	6
22–26	4
	91

Table II shows the status of 100 patients in January 1951.

The nine who could not be evaluated were eliminated from consideration for the following reasons:

No. 6. Patient could not be traced after initial therapeutic dose of I^{131}.

No. 18. Psychotic at time of treatment. Within two months became unmanageable and was committed to a sanitarium. Later died of tuberculosis.

No. 26. Rheumatic pancarditis developed. Treatment was changed to propylthiouracil and patient lost to follow-up.

No. 47. Patient did not understand that he had been treated. He thought he had been tested only. Was operated upon elsewhere.

No. 51. Lost after one month.

No. 73. Complicated by mixed therapy; evaluation impossible.

No. 85. Difficult to be sure the patient had hyperthyroidism at the time of treatment.

No. 93. Indigent out-of-state patient; could not remain; operated upon and sent home.

No. 95. Patient insisted upon operation six months after beginning I^{131} therapy.

TABLE II: STATUS OF PATIENTS AS OF JANUARY 1951

Year Therapy Started	Number of Patients	Unable to Evaluate	Achieved Remission	Lost to Follow-up Still Sick	Lost to Follow-up in Remission	Hypothyroidism	Recurrence	Death
1945	4	0	4	0	0	0	0	1
1946	26	3	22	1	3	2	? ?1	2
1947	35	2	33	0	10	2	1 + ?1	0
1948	18	2	16	0	4	5	?2	0
1949	17	2	14	1	6	1	?2	0
TOTAL	100	9	89	2	23	10	1? + ?6	3

In 89 patients remission was achieved, *i.e.*, the signs and symptoms of hyperthyroidism disappeared, the thyroid returned to normal size, and the laboratory findings no longer suggested hyperthyroidism even though the patient might have hypothyroidism and/or exophthalmos.

The time required for achievement of remission after initiation of I^{131} therapy is shown in Table III.

TABLE III: TIME REQUIRED FOR REMISSION IN 81 PATIENTS

Time for Remission After Beginning Therapy	*Number of Patients*
Less than 2 months	16
Less than 4 months	50 (56%)
Less than 6 months	63
Less than 8 months	70 (79%)
Less than 10 months	78
Less than 12 months	79
Less than 14 months	83
Less than 22 months	85 (96%)
Less than 30 months	87
Time unknown*	2

* These two patients were lost after their last dose and were later traced and found to be well without further treatment.

Hypothyroidism of mild to moderate degree developed in 10 patients as a result of the I^{131} therapy and was first noted in these patients one, one, one, two, three, nine, fourteen, twenty-five, thirty, and thirty-three months after the conclusion of their treatment. No cases of real myxedema were seen.

If the physician in charge gave a patient thyroid after he had received I^{131} therapy for hyperthyroidism (excluding those who received thyroid only for exophthalmos), that patient was classified as hypothyroid, though in some of these cases the physicians in this project did not have the opportunity to satisfy themselves that thyroid was needed.

If a patient was once considered to be in remission from hyperthyroidism and further treatment was then administered, that patient was classified as having had a recurrence. In certain patients the clinical picture suggested recurrence but it was not sufficiently convincing that further treatment was given. These cases were classified as questionable recurrences. Of the 100 patients considered here, one had a recurrence and 6 had questionable recurrences.

Three patients died subsequent to I^{131} therapy for hyperthyroidism: Patient No. 2 five years after the last dose of I^{131}, of aplastic anemia following masantoin therapy for epilepsy; Patient No. 18 two and a half years following the last dose of I^{131}, from tuberculosis, in an insane asylum; Patient No. 30 four years after the final I^{131} therapy from idiopathic acute yellow atrophy of the liver.

All three deaths occurred and autopsies were done elsewhere. Unfortunately, no tissue specimens could be obtained for study here. According to the autopsy reports, no definite evidence of tissue damage attributable to radiation was found. The thyroids were not examined.

PLACE OF I^{131} AMONG VARIOUS METHODS AVAILABLE FOR THE TREATMENT OF HYPERTHYROIDISM

The cause of hyperthyroidism is not known and therefore its treatment is empirical. The present methods of treatment consist of interruption of thyroid function by the administration of antithyroid drugs or by destruction of a part of the thyroid by surgery or radiation. We await with eagerness the appearance of some drug or method which will attack the disease at its source and make the present approaches obsolete.

The use of antithyroid drugs has its dangers and difficulties and has not proved to be uniformly successful in producing lasting good results. Of the various methods available for destroying a part of the thyroid, surgery has been used longest and in skillful hands has enjoyed good success. Surgery, however, subjects the patient to the pain, fear, and dangers, however small, of anesthesia, parathyroid removal, injury to nerves, and postoperative hemorrhage, as well as the expense of hospitalization.

It is known that in fully 20 per cent of patients operated upon for Graves' disease hypothyroidism develops following sub-

total thyroidectomy in this hospital. This radical approach has reduced the recurrence rate to approximately 2 per cent.

The use of either externally or internally administered radiation therapy permits relatively good control of the rate and amount of thyroid destruction, and because of this should succeed in bringing the patient to the normal level of thyroid function without necessarily inducing hypothyroidism. Radiation therapy is given routinely on an ambulatory basis.

Externally administered radiation must penetrate the skin in order to reach the thyroid, and subjects the normal structures around the thyroid to irradiation. This may produce damage to the skin and other organs. The major difficulty has been injury to the larynx and esophagus. With skillful application, however, this injury is negligible. The results of the external radiation therapy of hyperthyroidism compare favorably with the results of any other method of treatment.

Internal radiation can be given to the thyroid by radioiodine, which is taken up selectively in the cells of the gland that are metabolizing iodine. Presumably, these are the cells most concerned with the overproduction of the thyroid hormone. This means that the radiation originates in them and has the opportunity to destroy them with a minimal effect on the tissue not concerned in iodine metabolism. This selective radiation of cells that are thought to be deeply involved in the syndrome recognized as hyperthyroidism is the basis of the use of I^{131} for therapy of this condition. The radiation from radioiodine is given continuously but at a constantly diminishing low rate in contrast to that from externally applied x-rays, where the radiation is delivered usually in short bursts of equal size.

The dose of I^{131} given to the thyroid depends upon the amount of the isotope given by mouth and upon the ability of the thyroid to concentrate and retain it. All of the body is subjected to some irradiation. Certain organs, such as the kidneys, liver, salivary glands, and stomach receive amounts of radiation in excess of the average general body radiation. With the dosage levels used in the treatment of hyperthyroidism, however, neither objective nor subjective evidence of injury to these organs is forthcoming. While it has been stated that radioiodine is too slow in its action, many patients with hyperthyroidism are markedly improved within a few weeks; in some, improvement has been so dramatic that the time required for successful treatment is approximately the same as that which would have been required for preparation for surgery. It was suggested by Soley that patients treated by radiation were less likely to be the victims of serious eye complications than those treated surgically.

It seems timely to discuss the conditions under which any radioisotope is usable for the therapy of disease. These are as follows: (1) The disease process must be capable of being treated successfully by radiation; (2) the isotope must have a physical half-life sufficiently long to be useful practically, but (3) not so long as to make its use dangerous; (4) it must be concentrated in the tissue to be treated; (5) it must not be concentrated in other tissues of the body in dangerous quantities; (6) it must remain in the tissues to be treated long enough to permit effective irradiation; (7) its main radiation components should have either alpha- or beta-particles so that its radiation effects are largely limited to the tissue to be treated; (8) preferably, it should have a small component of penetrating radiation, a hard gamma-ray, so that the concentration of the isotope *in vivo* can be determined by measurement of this radiation outside of the patient; (9) ideally, the radiation dose to the tissue should be measurable with certainty, but practical results can be accomplished without perfect measurement. Radioiodine, by these criteria, should be, and is, an excellent therapeutic agent for patients with hyperthyroidism.

Successful and safe conduct of a radioiodine center for treatment of hyperthyroidism requires in its staff a basic knowl-

edge of radioactivity and technic, of radiation effects on tissue, and of the clinical and pathological manifestations of the disease process to be treated. It is unwise and unsafe to embark upon an isotope program unless each of these areas of knowledge is covered adequately by the staff.

SUMMARY

Data on the first 100 consecutive patients treated with radioactive iodine for hyperthyroidism at the University of California Hospital are presented. Methods of patient selection and treatment and the results of such treatment are given. The results of radioiodine therapy for hyperthyroidism in patients without nodular goiters are satisfactory. Follow-up studies of patients, up to five years in some cases, have shown a striking absence of recurrence. The number of patients rendered hypothyroid by this treatment is not more, and may be less, than following surgery. Further experience may permit us to reduce the incidence of this complication. No untoward effect of the treatment, except hypothyroidism, has become evident in the follow-up of this group of patients.

The place of radioiodine in the therapy of hyperthyroidism is considered.

ACKNOWLEDGMENT: Special thanks are given to Dr. Robert S. Stone, in charge of the project under whose auspices this work was done, and to Dr. Shields Warren, Director, Division of Biology and Medicine, AEC, for their co-operation.

Acknowledgment is also made of the technical assistance of Marian Feigenbaum, Enid Moor, and Louise Prestige.

SUMARIO

Estudios con Radioyodo. II. Tratamiento de los Hipertiroideos con I^{131}

Los datos presentados abarcan los primeros 100 enfermos consecutivos tratados por hipertiroidismo con radioyodo (I^{131}) en la Universidad de California. No se aceptaron para tratamiento enfermos con bocio nodular o con embarazo reconocido. El diagnóstico se hizo por justipreciación del estado clínico, apoyada por los hallazgos de laboratorio.

A continuación de una dosis inicial de ensayo de 100 microcuries de I^{131}, se obtuvo una curva de absorción, basada en determinaciones ejecutadas durante un período mínimo de cuatro días. Por esa curva de absorción y el peso computado del tiroides, se calculó la cantidad de I^{131} necesaria para llevar al tiroides 6,000 equivalentes roentgens beta, administrándose esa dosis por vía oral. Seis semanas después se obtuvo otra curva de absorción después de una dosis de ensayo, y se repitió el tratamiento si era menester, determinándose la dosis terapéutica por la respuesta al tratamiento anterior y el estado clínico del enfermo. Nuevo tratamiento fué administrado según parecía necesario. Las dosis más altas fueron de 22 a 26 milicuries en 4 enfermos.

En 89 casos se logró remisión; en 9 no pudieron valuarse los resultados y 2 enfermos se perdieron de vista sin remisión. En 10 enfermos se presentó hipotiroidismo que varió de leve a moderado, pero no notaron otros efectos contraproducentes. Los estudios subsiguientes han revelado notable ausencia de recurrencias.

A base de estas observaciones, y dadas las condiciones en que cabe usar cualquier radioisotopo terapéuticamente, dedúcese que el radioyodo constituye un excelente agente terapéutico para los hipertiroideos.

The Determination of Tissue Dosage[1]

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THE BASIS FOR any rational scheme of x-ray therapy is a knowledge of the dose at every point throughout the treated tissue. The purpose of this paper is to review the data and methods available to make such dosage assessments. In a problem of such complexity, it is helpful to consider first a simple case, the case in which the irradiated tissue is homogeneous and, effectively, infinitely large. To anticipate, we will conclude that under these restrictions the available data and methods are adequate for clinical purposes.

There is general agreement that for radiotherapeutic purposes such a homogeneous block of tissue may be approximated by a tank or phantom of water. It would thus be possible—but most laborious—for each radiotherapist to calibrate every port and every setting of his own equipment by direct measurement in a water tank. Fortunately it has been found that, in so far as the distribution of dosage in the beam is concerned, an x-ray beam can be characterized for clinical purposes by the target-skin distance (T.S.D.), the half-value layer of the radiation (h.v.l.), and the port. This seems to be especially true of modern machines having beams which are symmetrical about the beam axis and with a sharp drop-off of radiation at the edges, in contrast to the wide and variable penumbras and the anode-cathode asymmetries found on older sets.

There is a copious amount of data in the literature on the dose along the central axis of a square or round portal as a function of depth under the surface, tabulated over a wide range of half-value layer, target-skin distance, and port area. Unfortunately, the agreement among tables of different experimenters is not striking—illustrating, incidentally, how difficult it would be for each radiotherapist to construct his own. The two most widely used tables are those of Mayneord and Lamerton (1) and the tables given by Quimby (2) and supplemented by Braestrup *et al.* (3) (called in this paper the Quimby-Braestrup tables). The differences between these tables are large enough to be clinically significant, the Mayneord and Lamerton tables frequently giving values 10 or 15 per cent of the depth dose higher than the other set. On the basis of the measurements of Oliver and Kemp (4), it appears quite certain that the Quimby-Braestrup tables are the more nearly correct, and it would seem unlikely that the values given there will have to be changed substantially in the light of future measurements.

The most customary and convenient way of giving dosage in the radiation field off the central axis seems to be in the form of so-called "isodose charts," of which an example is shown in Figure 1. For a circular field only a single such chart plotting the dose in a plane containing the central axis of the beam is necessary. For rectangular fields two charts are usually employed to give the dosage distribution in the two planes running through the central axis and parallel to the long and short sides of the port. Some such charts are already available, notably those from the Royal Cancer Hospital (London) (5) and from the British Hospital Physicists Data Scheme (6). Neither set represents the best data that are known today. Royal Cancer Hospital charts do not agree with the Quimby-Braestrup tables along the axis, and the shape of the isodose curves at the geometrical edge of the beam is quite different from that measured with a very small thimble chamber (7).

[1] From the Department of Radiology, Yale University School of Medicine, New Haven, Conn. Accepted for publication in November 1950.

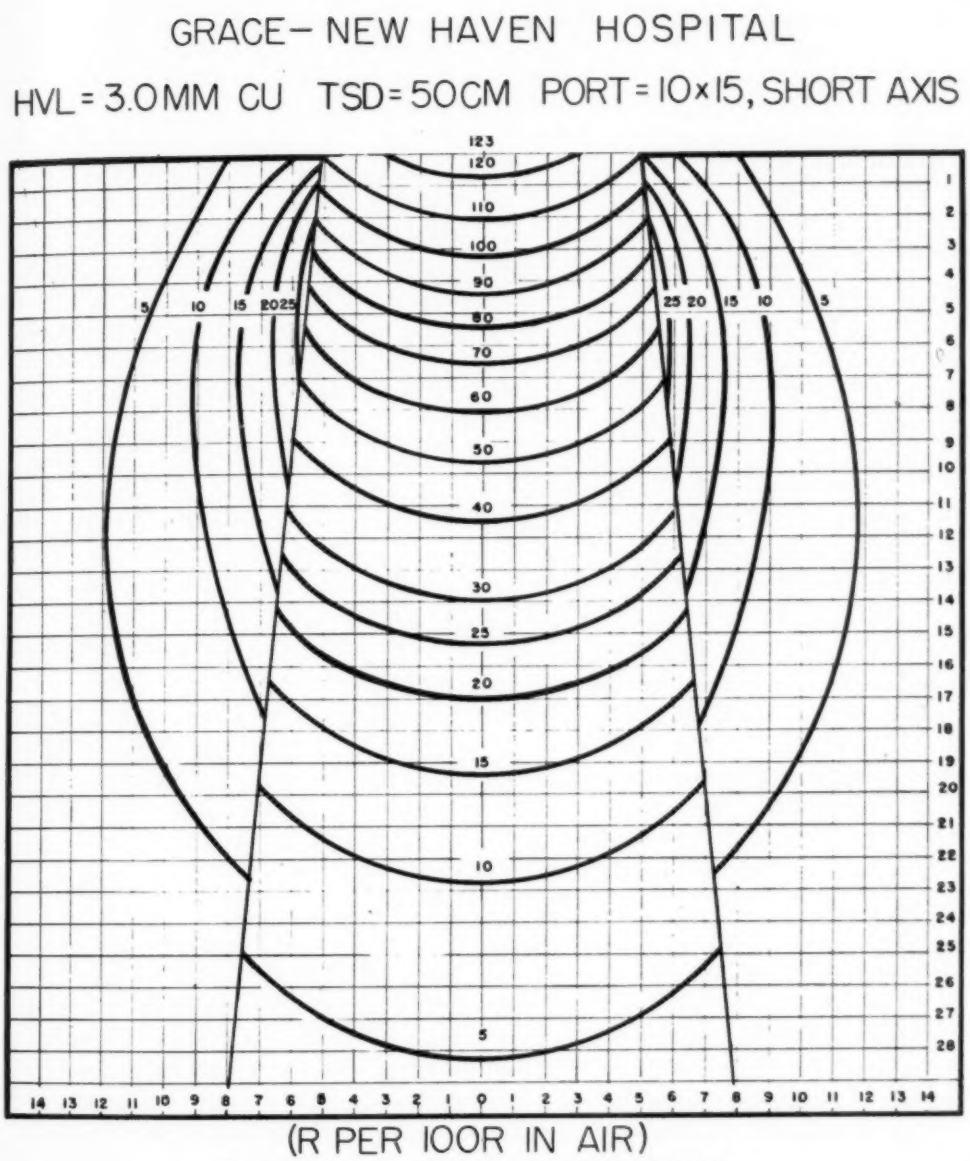

Fig. 1. Typical isodose chart (courtesy of Mr. M. Slater).

Most of the charts available from the Data Scheme have been calculated by a method due to Meredith and Neary (8). This is an approximate method for evaluation of the dose at any point in a radiation field. The values of the parameters involved are calculated from the axial depth doses for circular fields of different areas. Unfortunately the scheme is based on the Mayneord and Lamerton data, and thus the axial dosages, at least, are in general too high.[2] The general type of isodose

[2] It might be mentioned that the good agreement between the calculated and measured depth doses mentioned in reference 7 is explained by the fact that, for the particular port and h.v.l. used, the Mayneord-Lamerton and Quimby-Braestrup tables are in quite good agreement.

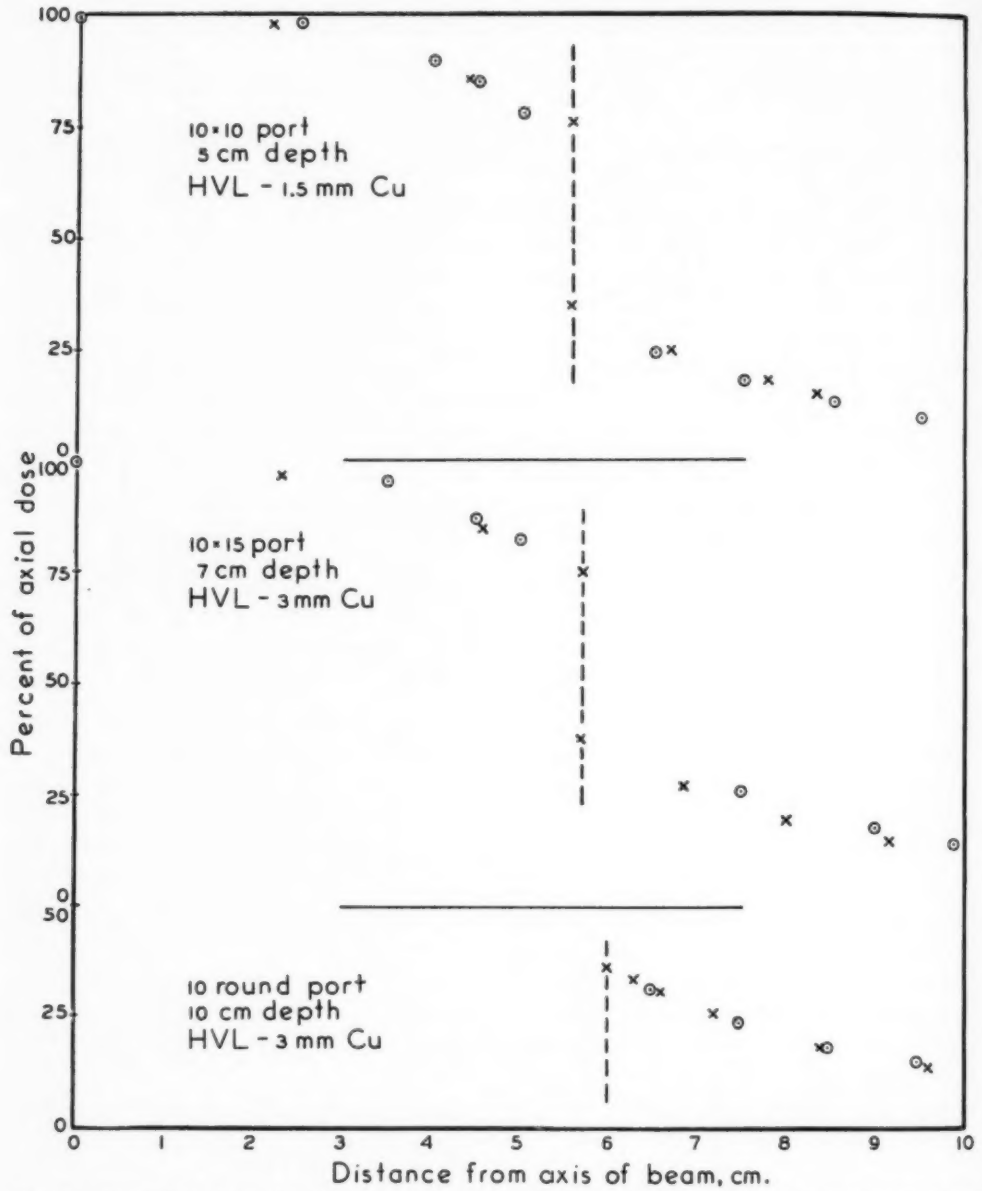

Fig. 2. Comparison of experimental measurements of the dose at various distances from the axis of the x-ray beam, expressed as a percentage of the axial dose (circles), and values calculated by the method of Meredith and Neary (crosses). The three curves are for three different combinations of port size, half-value layer, and depth in the phantom, with the vertical dashed line marking the geometrical edge of the beam. Data for the bottom curve show only the scattered radiation outside the beam.

curve obtained, however, is very much like that obtained by experiment (7).

Several other methods of calculating off-axis dosages are given in the literature (9–11). None, however, seems to be as general or as free from objection as the Meredith and Neary theory, and it seemed worth while to see how accurate the theory would be if the central axis doses were forcibly made to agree with the Quimby-

Braestrup values. The straightforward way of doing this would be to recalculate the various parameters on the basis of the more accurate axial depth doses. Instead of carrying out this laborious task, a simple way was tried. The doses at a depth of d cm. below the surface, calculated by the ordinary Meredith and Neary theory, were first expressed as percentages of the central axis dose at that depth. The actual dose at some off-axis point would then be found by taking the corresponding percentage of the Quimby-Braestrup axial dose at that same depth. For example, if the calculated dose at a point outside the geometrical beam were 20, the calculated axis dose 60, and the Quimby-Braestrup value 57, the off-axis dose would be $20 \times \frac{57}{60} = 19$.

If the port is long and narrow, the calculated ratio cannot be obtained as described above because there is also a decrease in the axial dose, due to elongation of the port, which must be taken into account. When this elongation correction is important, it can most easily be incorporated by multiplying the axial dose calculated for the elongated port by the ratio of the Quimby-Braestrup value to the Mayneord-Lamerton value for circular ports.

To check the validity of values thus calculated, experimental measurements were made of the way in which the dose varied with distance from the axis at a fixed depth. This was done for ports of different size and at different depths with radiation of two different qualities, 1.5 mm. and 3 mm. Cu h.v.l. A presdwood phantom and a Victoreen 25 r chamber were used. The central axis depth doses measured were in very good agreement with the values given in the Quimby-Braestrup tables.

For a certain port and quality of radiation, say a 10 × 10-cm. port and 1.5 mm. Cu h.v.l., the measured values at a certain depth, say 5 cm., were plotted as a function of distance from the central axis of the beam. It was convenient to adjust the central axis dose to 100 and express the off-axis values as percentages of the central dose at the same depth (see Fig. 2, top curve). On the same graph were then plotted the calculated points for the same port size, h.v.l., and depth, with the axial dose again adjusted to 100, and the off-axis points again expressed as fractions of this central axis dose. If the theory is correct, the two sets of points should fall on the same curve. This they do to quite a fair degree of accuracy.

A number of such curves were plotted for different ports, h.v.l.'s, and depths, of which three are shown in Figure 2, including the one (center) with the greatest discrepancy between calculation and experiment. No consistent differences were noticed—*i.e.*, on some curves the experimental points were higher than the calculated ones, and on others lower.

The good general agreement between the experimental and calculated points not only justifies the corrections made to the theory, but is also important evidence for the validity of the whole Meredith-Neary scheme. There is curiously little evidence on this point in the literature at the present time.

It might be well to note here that for rectangular ports the calculation of isodose curves from Meredith and Neary's tables is quite tedious, much more so than for circular ports. Mitchell (12), however, has provided a set of tables, available from the British Hospital Physicists' Data Scheme, which make the calculation of rectangular ports no more difficult than of round ones.

It has been shown before (13) that depth dose tables, and therefore isodose charts, must be corrected to take into account the presence of covers across the ends of therapy cones. Any complicated corrections can most easily be avoided by making the cone covers out of a material as similar to tissue as possible—presdwood, or even lucite or plexiglas. The x-ray output is measured with the cone cover removed, and is corrected to the plane of the surface of the cone cover away from the patient. The effect of the cone cover in place is thus only that of slightly increasing the distance to a fixed spot in the irradiated tissue. If

1/16-inch plexiglas is used, the depth correction is only 1.5 mm. and may safely be ignored.

It appears that dosage may now be calculated at any point in irradiated tissue, subject only to the restrictions that the tissue can be considered as homogeneous and that the irradiated section be large enough so that full scatter is obtained. The errors involved in neglecting these factors cannot be dismissed lightly, but in our present state of imperfect knowledge the information obtained by the application of the methods described above can give a most valuable first approximation.

SUMMARY

On the basis of the information in the literature, it appears that the most reliable set of depth dose data is that of Quimby and Braestrup. Doses at points off the axis may be calculated by a method devised by Meredith and Neary, but the numerical values of the parameters in their theory need to be changed to make them agree with the Quimby-Braestrup data.

An approximate way of making this correction is first to calculate an off-axis dose as a percentage of the dose in the center of the field and at the same depth. The actual dose at the desired point is then found by taking this percentage of the axis dose given in the Quimby-Braestrup tables. Experimental data show that this correction is sufficiently accurate, and give additional evidence as to the validity of the Meredith and Neary theory.

The effect of cone covers on depth dose curves is best taken into account by making the covers from material reasonably similar to tissue. If the x-ray output is then measured with the cover off, the effect of a tissue-like cover is only to increase slightly the depth to a given spot.

Thus, it is now possible to calculate with reasonable accuracy the dosage in any part of a radiation field, subject only to the conditions that the irradiated tissue can be considered homogeneous and large enough to give full scatter.

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SUMARIO

La Determinación de la Dosis en los Tejidos

A base de la información aportada por la literatura, parece que el conjunto más fidedigno de datos relativos a dosis profundas es el de Quimby y Braestrup. Las dosis en los puntos fuera del eje pueden calcularse con un método propuesto por Meredith y Neary, pero hay que modificar los valores numéricos de los parámetros comprendidos en su teoría a fin de que convengan con los datos de Quimby-Braestrup.

Un modo aproximado de hacer esa recti-

ficación consiste en calcular primero una dosis ex-eje como porcentaje de la dosis en el centro del campo y a la misma profundidad. Luego se busca la dosis real en el punto deseado tomando dicho porcentaje de la dosis eje dada en las tablas de Quimby-Braestrup. Datos experimentales demuestran que esa rectificación es suficientemente exacta y aportan nuevas pruebas de la validez de la teoría de Meredith y Neary.

El efecto de los recubrimientos de los conos sobre las curvas de las dosis profundas se toma mejor en cuenta fabricando dichos recubrimientos de substancias bastante semejantes a los tejidos. Si se mide entonces la emisión de rayos X con el recubrimiento quitado, el efecto de un recubrimiento parecido a tejido no es más que un leve aumento de la profundidad en un sitio dado.

Por lo tanto, ya es posible calcular con bastante exactitud la dosis en cualquier parte de un campo de irradiación, con la sola condición de que quepa considerar homogéneo el tejido irradiado y de que éste sea suficientemente extenso para permitir plena dispersión.

Selection of Optimum Kilovoltage for Dental Radiography

I. Preliminary Studies[1]

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THE MOST COMMONLY used dental x-ray machines are designed to operate at kilovoltage peaks ranging from 50 to 70. There are no investigations in the dental literature which prove that this range will produce dental films most suitable for diagnosis, and the recent recommendations by Fitzgerald (1) are for dental x-ray equipment capable of producing higher kilovoltages than are available at present.

Medical radiologists are not limited by a narrow kilovoltage range in their equipment nor by lack of information concerning optimum values for specific body areas. They recognize that different kilovoltages are required for acceptable penetration and have experimentally tested high voltages in the production of diagnostic films (2–6). It appears that this type of information would be valuable also to dental radiologists. The purpose of this investigation was to test the applicability of the high-kilovoltage technic to dental radiography and to determine the optimum kilovoltage for production of dental radiographs that are capable of demonstrating both hard- and soft-tissue lesions with one exposure.

The investigation involved the study of radiographic contrast, which is defined as the degree to which a film will demonstrate differences in radiopacity over a given range of structural density.

Many authors have expressed a preference for a film giving "high contrast" (7–12). Such films are "brilliant" and have sharp distinctions between tissues of differing radiopacity. Slight differences in a single tissue are readily apparent. The question unanswered at present is what degree of contrast is necessary to produce a film of highest diagnostic value. The contrast should be such that variations in all important structures can be easily seen; soft tissues should be differentiated from fluids and tissue voids, while on the same film sound enamel must be distinguishable from dentine, carious enamel, and metallic restorations. This goal is not achieved at the present time. In order to obtain the extremes of the radiopacity range in the oral cavity, it is an accepted procedure to utilize double-packet films and develop one of the exposures less than full time.

Any study of contrast involves radiographic density, since both qualities of dental film are affected by the three basic factors—the type of film, the developing technic, and the tube kilovoltage. In addition, density is influenced by target-film distance and milliampere seconds of exposure. A change in kilovoltage alone will make a difference in the contrast but will also cause the density to be unsatisfactory. In order to maintain constant density, the milliampere seconds of exposure must be adjusted to compensate for each new tube potential. All other factors, such as film processing, type of film, and target-film distance, must be kept constant in each experiment.

EXPERIMENTAL PROCEDURE

The x-ray equipment used in this study consisted of a shock-proof full-wave rectifier having a capacity of 200 ma. at 90 kv.p. or 10 ma. at 110 kv.p. It was equipped with a shock-proof transformer, a filament stand-by voltage and amperage stabilizer accurate to ± 5 per cent, a milliamperage stabilizer accurate to ± 10 per cent, and a synchronous timer with a

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TABLE I: KILOVOLTAGE AND MILLIAMPERE SECONDS TO PRODUCE CONSTANT FILM DENSITY THROUGH 2 MM. OF ALUMINUM

(Kodak No-Screen Film; 36 inches Target-to-Film Distance)

Kv.p.	Ma. Sec.	Average Density
110	7	2.55
105	7	2.54
100	9	2.68
95	9	2.43
90	10	2.42
85	10	2.22
80	12	2.27
75	14	2.27
70	16	2.40
65	19	2.39
60	23	2.41
55	28	2.40
50	36	2.45
45	49	2.53
40	70	2.50
35	120	2.84
30	210	2.68

It will be noted that the densities are not absolutely constant but they are as nearly constant as possible. The inconsistency is due to an inability to break the milliampere seconds into fractions.

range of 1/10 to 14 seconds, accurate to 12 ± 1 impulse per 1/10 second as checked with the spinning top. The x-ray tube was a shock-proof, oil-immersed, air-flow, double-focus type with focal spots of 1.5 and 3.8 mm. Only the 1.5-mm. focal spot was used. The output of the machine was 2.82 r per second in air at 23 cm. target-skin distance, 70 kv.p., and 10 ma., with no extrinsic filtration. Under these conditions, the half-value layer was 0.8 mm. Al. The kilovoltage as recorded on the pre-reading primary voltmeter calibrated to include line drop was checked at installation and following completion of the investigation. It was found to be both consistent and accurate. In a like manner the line voltage was checked. It was 207 volts with no perceptible drop at 10 ma., a 1.0-volt drop at 50 ma., and a 1.5-volt drop at 100 ma. The above values were obtained at 60 kv.p.

Two types of cones were used. One was a steel extension cone, having a minimum length of 10 inches and a maximum length of 17 1/2 inches with a 4 1/4 inch aperture at its extreme end. No diaphragm was used with this cone. The opening of the cone connected to the tube housing was 2 1/4 inches. The second type of cone used could be adjusted to lengths of 11 inches, 15 inches, and 18 inches, and had an opening of 3 inches.

The film employed was Kodak no-screen film No. 4. The solutions used were of a standard formula. The films were developed at seven and a half minutes at 65° F. ± 1°, washed for a minimum of thirty seconds between developer and fixer in running water, and fixed for fifteen minutes. Following fixing, the films were washed in running water for twenty minutes. They were processed on hangars, agitated by hand, and dried in air. An aluminum step-tablet measuring 9 3/4 inches in length, composed of 19 thicknesses of 1-mm. aluminum was used. Each step was 1 × 3/8 inch.

RESULTS

Determination of Proper Exposure for Different Tube Voltages: The general purpose of the first phase of the study was to adjust the milliampere seconds of exposure so that different tube voltages would produce the same density on film after the rays had traversed a certain amount of soft tissue. One step of the aluminum step wedge was employed to provide a standard of known radiopacity, which would be approximately equivalent to soft tissue. Two millimeters of aluminum were selected as being an approximate representation of the radiopacity of the soft tissue; experiments to be reported later will indicate that this choice was proper. It had the further advantage that the 1-mm. and 3-mm. steps would provide different densities on the film, giving an index of the sensitivity of the film for disclosing radiopacity changes.

The milliampere seconds of exposure required at different kilovoltage peaks was determined empirically. An effort was made to produce films having a density[4] of 2.4, which would allow for a readily measurable density change in either direction. Data are presented in Table I on the kilovoltage and milliampere seconds employed and the resulting density of the film.

[4] Defined as $\log_{10} (I_0/I)$ where I_0 = incident light and I = emergent light.

TABLE II: DENSITY OF STEPS OF 1.0 MM. ALUMINUM
(Kodak No-Screen Safety Film)

Step No.	110 kv.p. 7 ma.s.	105 kv.p. 7 ma.s.	100 kv.p. 9 ma.s.	95 kv.p. 9 ma.s.	90 kv.p. 10 ma.s.	85 kv.p. 10 ma.s.	80 kv.p. 12 ma.s.	75 kv.p. 14 ma.s.	70 kv.p. 16 ma.s	65 kv.p. 19 ma.s.	60 kv.p. 23 ma.s.	55 kv.p. 28 ma.s.	50 kv.p. 36 ma.s.	45 kv.p. 49 ma.s.	40 kv.p. 70 ma.s.	35 kv.p. 120 ma.s.
1	3.00–	2.94	3.00	3–	3	2.72	2.88	2.92	3–	3–	3–	3–	3–	3–	3–	3–
2	2.55	2.54	2.68	2.43	2.42	2.22	2.27	2.268	2.40	2.39	2.41	2.40	2.45	2.53	2.50	2.84
3	2.22	2.10	2.30	2.10	2.11	1.88	1.93	1.938	2.03	2.05	1.98	1.96	2.01	2.03	1.95	2.06
4	1.94	1.77	2.02	1.83	1.85	1.62	1.67	1.642	1.74	1.72	1.63	1.61	1.63	1.64	1.51	1.60
5	1.72	1.58	1.81	1.63	1.64	1.39	1.43	1.448	1.53	1.47	1.38	1.34	1.35	1.33	1.18	1.27
6	1.55	1.40	1.64	1.45	1.45	1.21	1.28	1.224	1.34	1.27	1.17	1.14	1.14	1.10	0.982	0.999
7	1.38	1.25	1.48	1.29	1.28	1.09	1.14	1.084	1.17	1.12	1.03	0.985	0.964	0.911	0.795	0.802
8	1.27	1.14	1.34	1.17	1.17	0.980	1.01	0.956	1.05	1.005	0.927	0.861	0.826	0.752	0.648	0.633
9	1.14	1.05	1.21	1.07	1.05	0.877	0.918	0.845	0.936	0.868	0.808	0.734	0.703	0.617	0.538	0.519
10	1.06	0.945	1.12	0.980	0.946	0.796	0.818	0.760	0.847	0.774	0.709	0.639	0.606	0.535	0.456	0.431
11	0.973	0.866	1.03	0.912	0.870	0.720	0.729	0.678	0.764	0.689	0.635	0.576	0.535	0.466	0.400	0.362
12	0.896	0.780	0.950	0.840	0.787	0.653	0.658	0.597	0.676	0.605	0.559	0.519	0.475	0.414	0.343	0.316
13	0.828	0.720	0.883	0.776	0.726	0.587	0.605	0.553	0.612	0.561	0.515	0.470	0.430	0.368	0.309	0.280
14	0.761	0.655	0.815	0.702	0.672	0.530	0.550	0.506	0.563	0.524	0.466	0.418	0.384	0.331	0.281	0.251
15	0.697	0.596	0.760	0.645	0.604	0.489	0.514	0.462	0.518	0.462	0.423	0.377	0.348	0.299	0.255	0.230
16	0.640	0.557	0.709	0.592	0.566	0.451	0.469	0.427	0.478	0.426	0.394	0.344	0.322	0.268	0.234	0.215
17	0.590	0.516	0.644	0.554	0.519	0.417	0.430	0.397	0.447	0.394	0.364	0.320	0.294	0.253	0.214	0.200
18	0.538	0.463	0.597	0.516	0.478	0.383	0.396	0.358	0.424	0.362	0.345	0.293	0.272	0.232	0.200	0.191
19	0.488	0.430	0.539	0.464	0.448	0.352	0.364	0.330	0.380	0.333	0.300	0.268	0.247	0.222	0.190	0.180
n*	0.180	0.172	0.175	0.164	0.177	0.168	0.157	0.168	0.169	0.185	0.148	0.177	0.153	0.174	0.148	0.152

* Step n is in each case the transmission density of the unexposed film. All exposures at 36 inches target-to-film distance.

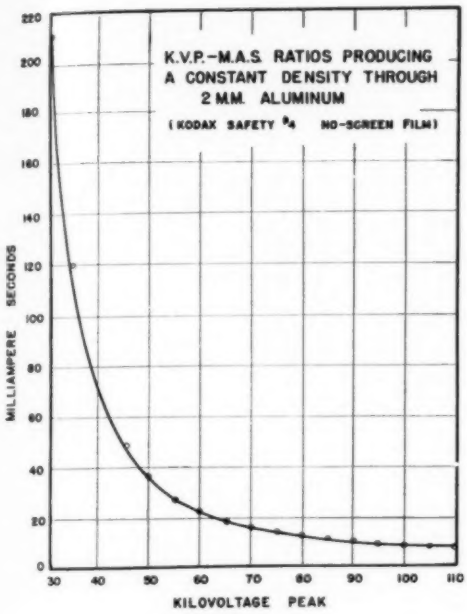

Figure 1

All films were developed simultaneously. The deviation of density from 2.4 is attributable in part to variations in film and developing and in part to the limitations of the synchronous timer. The relationship between kilovoltage peak and milliampere seconds required to produce a constant density is shown in Figure 1 in the form of a smooth curve. All the readings on the 2-mm. step were taken with a Weston health protection densitometer and were the average of five observations.

Film Density Under Step-Tablet at Different Tube Potentials: The transmission density was determined in quintuplicate on each of the films for each of the 19 steps. The average density is presented in Table II. As mentioned before, the density under 2.0 mm. of aluminum was regulated to be as nearly constant as possible. The density change between adjacent steps and between the extremes of aluminum thickness is greater for films exposed with a low kilovoltage peak than those exposed with a high kilovoltage. The density of the unexposed film (step *n*) is more nearly equal to the density of the film under the thickest part of the step-tablet when exposure is made with low kilovoltage. Visually it is difficult to determine film density differences between the more dense adjacent steps exposed at low kilovoltage (Fig. 2). For example, at 35 kv.p. density differences can just be seen between steps 9 and 10, while at 110 kv.p. there are readily observable differences between steps 17 and 18. One observer (A.H.W.) could just distinguish by eye film density differences ranging from 0.036 to 0.068, and averaging 0.050. These observations were taken over a film density range of 0.316 to 0.719 (Tables II and III). Numerical values for film density lost practical significance below approximately 0.4, since areas of the film having this density begin to appear too light to the eye. This means that many of the values in the lower right portion of Table II, corresponding to the high thicknesses of aluminum and low kilovoltage range, are of less diagnostic significance. This suggests that, if oral structures possess radiopacity corresponding to the complete ranges of the step-tablet, the low kilovoltage range is less suitable for obtaining films which will disclose density changes in all tissues.

The differences between density of adjacent steps on the step-tablet, presented in Table III, are obtained by subtracting densities on adjacent steps as given in Table II. The density of step 1 in Table II was too high to be read with sufficient accuracy. Hence, the differences between steps 1 and 2 have been omitted. As would be expected, differences in transmission density between steps 2 and 3 are very similar for all kilovoltages. This indicates that all of the films would tend to produce similar contrast for examination of soft tissue. From the fourth to the tenth step, there is a greater density change between steps for the low-kilovoltage films than for the high. Beyond the tenth step, high-kilovoltage films show a greater density difference between steps than do the low-kilovoltage films. At the thirteenth step, for example, the difference is almost twice as great, and at the eighteenth step it is three times as great.

TABLE III: DIFFERENCES IN DENSITY BETWEEN STEPS OF 1.0 MM. ALUMINUM

Steps	110 kv.p.	105 kv.p.	100 kv.p.	95 kv.p.	90 kv.p.	85 kv.p.	80 kv.p.	75 kv.p.	70 kv.p.	65 kv.p.	60 kv.p.	55 kv.p.	50 kv.p.	45 kv.p.	40 kv.p.	35 kv.p.
2–3	0.33	0.44	0.38	0.33	0.31	0.34	0.34	0.330	0.37	0.34	0.43	0.44	0.44	0.50	0.55	0.78
3–4	0.28	0.33	0.28	0.27	0.26	0.26	0.26	0.296	0.29	0.33	0.35	0.35	0.38	0.39	0.44	0.46
4–5	0.22	0.19	0.21	0.20	0.21	0.23	0.21	0.194	0.21	0.25	0.25	0.27	0.28	0.31	0.33	0.33
5–6	0.17	0.18	0.17	0.18	0.19	0.18	0.18	0.224	0.19	0.20	0.21	0.20	0.21	0.23	0.198	0.271
6–7	0.17	0.15	0.16	0.16	0.17	0.12	0.14	0.140	0.17	0.15	0.14	0.155	0.176	0.189	0.187	0.197
7–8	0.11	0.11	0.14	0.12	0.11	0.11	0.13	0.128	0.12	0.115	0.103	0.124	0.138	0.159	0.147	0.169
8–9	0.13	0.09	0.13	0.10	0.12	0.103	0.092	0.111	0.114	0.137	0.119	0.127	0.123	0.135	0.110	0.114
9–10	0.08	0.105	0.09	0.090	0.104	0.081	0.100	0.085	0.089	0.094	0.099	0.095	0.097	0.082	0.082	0.088
10–11	0.087	0.079	0.09	0.068	0.076	0.076	0.089	0.082	0.083	0.085	0.074	0.063	0.071	0.069	0.056	0.069
11–12	0.077	0.086	0.08	0.072	0.083	0.067	0.071	0.081	0.088	0.084	0.076	0.057	0.060	0.052	0.057	0.046
12–13	0.068	0.060	0.067	0.064	0.061	0.066	0.053	0.044	0.064	0.044	0.044	0.049	0.045	0.046	0.034	0.036
13–14	0.067	0.065	0.068	0.074	0.054	0.057	0.055	0.047	0.049	0.037	0.049	0.052	0.046	0.037	0.028	0.029
14–15	0.064	0.059	0.055	0.057	0.068	0.041	0.036	0.044	0.045	0.062	0.043	0.041	0.036	0.032	0.026	0.021
15–16	0.057	0.039	0.051	0.053	0.038	0.038	0.045	0.035	0.040	0.036	0.029	0.033	0.026	0.031	0.021	0.015
16–17	0.050	0.041	0.065	0.038	0.047	0.034	0.039	0.030	0.031	0.032	0.030	0.024	0.028	0.015	0.020	0.015
17–18	0.052	0.053	0.047	0.038	0.041	0.034	0.034	0.039	0.023	0.032	0.019	0.027	0.022	0.021	0.014	0.009
18–19	0.050	0.033	0.058	0.052	0.030	0.031	0.032	0.028	0.044	0.029	0.045	0.025	0.025	0.010	0.010	0.011
19–n*	0.308	0.258	0.364	0.300	0.271	0.184	0.207	0.162	0.211	0.148	0.152	0.091	0.094	0.048	0.042	0.028

*Step n is in each case the transmission density of the unexposed film.

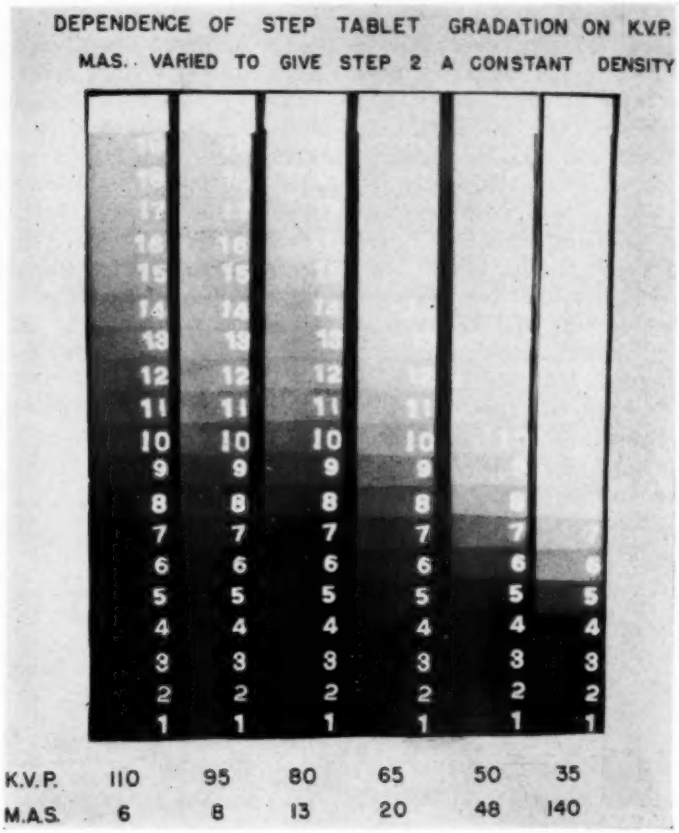
DEPENDENCE OF STEP TABLET GRADATION ON K.V.P.
M.A.S. VARIED TO GIVE STEP 2 A CONSTANT DENSITY
K.V.P. 110 95 80 65 50 35
M.A.S. 6 8 13 20 48 140

Figure 2

If the thinner end of the step-tablet is comparable to soft tissue and fine interproximal bone, the low-kilovoltage technic gives somewhat greater contrast but also greater risk of both underexposure and overexposure of structures of nearly equal penetrability. This especially applies when both hard and soft tissues are to be registered on the same film. If the thicker end of the step-tablet is comparable to cortical bone and tooth structures, the lack of density difference between adjacent steps indicates diminished contrast for dense structures.

Lateral Head Films at Different Tube Potentials: An attempt was made to utilize a dried specimen to demonstrate the effect of variations in kilovoltage on calcified structures. After some experimentation it was recognized that living subjects would have to be utilized, since dried specimens gave films with unnatural contrast and suitable moist autopsy specimens could not be obtained. Safe radiographic exposure factors were determined at various target-skin distances throughout the full kilovoltage range and with various filtration factors. The procedures and results of this phase of the investigation are described elsewhere.

In order to keep roentgen dosage within safe levels, observations with living subjects were made at every 15 instead of every 5 kv.p. throughout the range of 35 to 110 kv.p. The head was radiographed in a true lateral position with the aluminum step-tablet clamped to the film. All factors were consistent with the experiment using

the step-tablet alone, except that the milliampere seconds were decreased in order to demonstrate soft tissue. Having determined an exposure which would demonstrate soft tissue, the previously determined kv.p.-ma. sec. ratio was followed, with a constant percentage change in ma. The net result was one which demonstrated differentiation of hard structures more adequately in the high-kilovoltage range. Observations were repeated after increasing the milliampere seconds by 50 per cent. Hard structure differentiation appeared improved throughout the entire kilovoltage range and soft tissue was more generally burned out. Differentiation of hard structures was more improved for the high- than for the low-kilovoltage range. This conclusion is the same as that observed from the study with the step-tablet.

SUMMARY

The purpose of this study was to compare the diagnostic value of dental films at tube kilovoltages ranging from 35 to 110 kv.p., using as the criterion the film which demonstrates soft tissue and at the same time produces good differentiation of calcified structures of nearly equal radiographic density. The study made use of an aluminum step-tablet (with nineteen 1.0 mm. steps), no-screen x-ray film, and a Weston densitometer. By trial and error, the correct exposure in milliampere seconds was determined for each 5 kv.p. from 35 to 110 kv.p. as required to keep the density constant for film under 2.0 mm. of aluminum. Eight by ten no-screen film was exposed under the complete step-tablet at the chosen milliampere seconds for each 5 kv.p. from 35 to 110. The density of film under all steps was determined from the average of five readings. At 110 kv.p. adjacent steps under all parts of the tablet could be noted visually; at 35 kv.p. the gradations under the thicker parts of the tablet were too slight to be discerned.

These procedures were repeated on the living skull in a lateral position with the step-tablet placed in front of the nose in the mid-sagittal plane. Assuming that the radiopacity range in the mouth corresponds to the first fourteen steps of the step-tablet, it is necessary for optimum results to utilize tube potentials in excess of those commonly found in dental x-ray equipment.

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SUMARIO

Selección del Kilovoltaje Optimo para la Radiografía Dental. Estudios Preliminares

Tenía por fin este estudio comparar el valor diagnóstico de las radiografías dentales tomadas con kilovoltajes en el tubo que variaban de 35 a 110 kv., usando como pauta la radiografía que muestra el tejido blando y al mismo tiempo ofrece buena diferenciación de los tejidos calcificados de casi igual densidad radiográfica. En el

estudio se utilizó un tablero-escala de aluminio (con diecinueve escalones de 1.0 mm.), una película radiográfica sin pantalla, y un densitómetro de Weston. Con un sistema de yerra y corrige, se determinó la exposición correcta en miliamperios-segundos para cada 5 kv. de 35 a 110 kv., según se requería para mantener la densidad constante para radiografías bajo 2.0 mm. de aluminio. Se expuso película de 20 por 25 mm. sin pantalla bajo el tablero-escala a la cifra de miliamperios-segundos escogida para 5 kv. de 35 a 110. La densidad de la película en cada uno de los escalones fué determinada por el promedio de cinco lecturas. A 110 kv., los escalones adyacentes en todas las partes del tablero eran demasiado tenues para poder distinguirlos.

Estos procedimientos fueron repetidos en el cráneo viviente en una posición lateral con el tablero-escala colocado en frente de la nariz en el plano mesosagital. Suponiendo que la escala de radioopacidad en la boca corresponde a los primeros catorce escalones del tablero-escala, es necesario, para obtener resultados óptimos, utilizar en el tubo potenciales que excedan los obtenibles habitualmente en las instalaciones dentales de rayos X.

A New Film Projector for Full-Sized Original Roentgenograms[1]

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ONE OF THE least satisfactory phases of present day roentgenologic hospital practice is the lack of adequate facilities for projecting full-sized original roentgenograms for demonstration purposes at conferences, lectures, staff meetings, and in student classes. Presenting roentgenograms to large groups with conventional illuminators is a frustrating experience. Demonstration of fine detail, under these conditions, even to those in the first row of seats, is hardly possible. Passing the films around is less satisfactory. Conversion of roentgenograms into lantern slides is costly, time-consuming, and disappointing because of loss of detail.

The purpose of this paper is to present a new projector, constructed along the simplest lines, which makes possible efficient enlargement and projection of conventional roentgenograms of all sizes (Fig. 1). It fulfills most of the long sought features a lecturer, demonstrator, teacher, or audience would desire.

The instrument has been developed from war-surplus material. It projects a 6 × 6 foot image at a distance of 10 feet from the screen (Fig. 2). This permits its use in the small pit of a hospital or medical school amphitheater. As far as can be ascertained, this is not possible with other available film projectors capable of projecting full-size 14 × 17-inch roentgenograms (1–3).

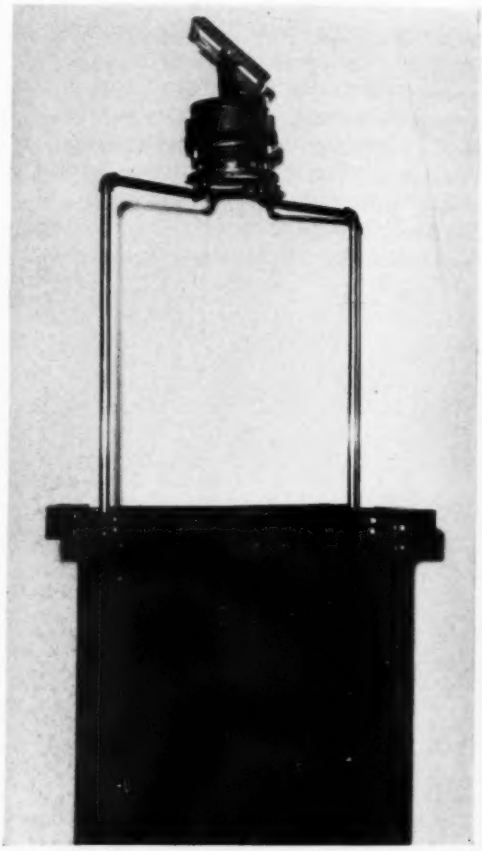

Fig. 1. Side view of projector showing simplicity of construction. Projection lens and first surface mirror visible.

At 30 feet distance the image can be "blown up" to 20 feet square without loss of appreciable sharpness or detail. Images of such proportions, however, are necessary only for unusually large groups.

The projection lens is a 24-inch F 6.2 aerial ectar camera lens used by the government for photography during the recent war. This is a very sharp lens, said to represent one of the optical engineering achievements of the war. At a distance of 25 inches it easily covers a 20-inch circle. An ordinary projection lens would have to be of very long focal length to cover such an area and of tremendous size to permit comparable illumination. Moreover, no ordi-

[1] From the Department of Diagnostic Roentgenology, Montefiore Hospital, New York. Accepted for publication in January 1951.

The development of the apparatus was aided by a grant from the research funds of Montefiore Hospital.

nary projection lens is ever so highly corrected for color, flatness of field, or for spherical aberration.

The condensing system (Fig. 3) consists of two "liquid" lenses constructed with two 19-inch searchlight mirrors made for the government by Bausch and Lomb. These were desilvered, filled with Esso's heaviest mineral oil, known to the trade as Primol D, and sealed over with a circular glass surface plate having a 1-inch hole adjacent to its margin. The sealing compound used is a commercial oil-resistant

Fig. 2. Image 6 × 6 feet obtained at a distance of 10 feet from the screen.

sealer made either by the Armstrong Cork Co. or the Minnesota Mining and Manufacturing Co. After "curing" for the proper number of hours, this substance becomes buna rubber. The filling of the lenses with oil is purposely left incomplete to allow room for expansion of the liquid due to the heat transmitted from the projection lamp. A permanent attachable

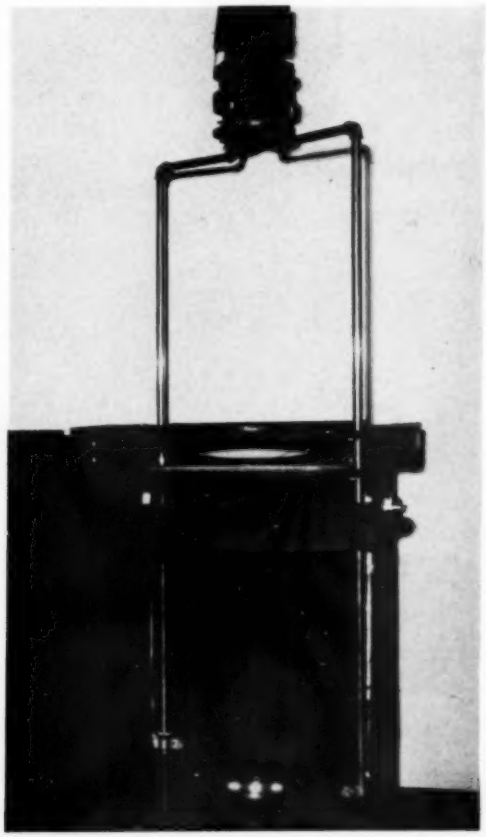

Fig. 3. Two "liquid" lenses making up the condenser system. The 500-watt lamp as a light source is visible.

reservoir is now under construction to permit collection of the expanded oil and thus obviate the need for incomplete filling. The finished condensing system has the same power as a solid glass lens of the same dimensions.

The condenser lenses are set into round plywood seats at an angle slightly off the true horizontal plane so as to permit the air bubble in each lens to communicate with the 1-inch hole in the circular surface plate. This is necessary in order to allow escape of air as the heat from the light source expands the oil. Once the oil reservoir is available, the off-horizontal setting of the condenser lenses will be obviated.

The source of light used is situated approximately 36 inches below the condens-

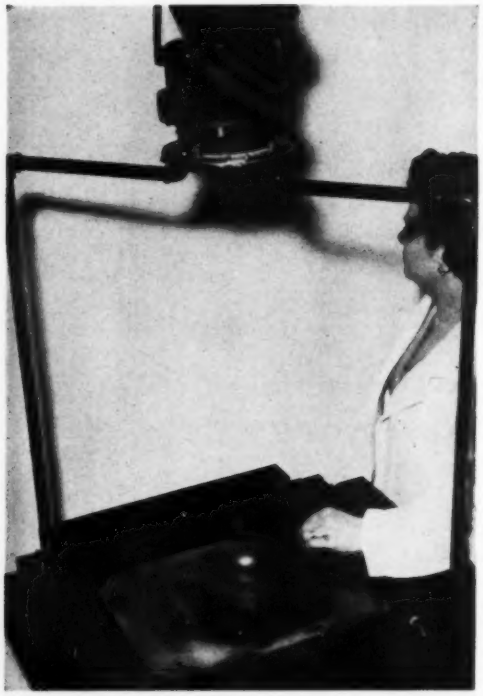

Fig. 4. Film in position on top condenser lens.

ing system. It consists of a 500-watt lamp known to the photographic trade as the RSP2 Reflector Photospot. This is placed in line with the optical axis of the entire system. The lamp is rated with a life of about six hours, which represents an expenditure of approximately twenty cents per hour. This cost is reduced even further if the lamps are purchased in numbers.

The heat transmitted through the condensing system to the film is low enough to permit a film to remain on the instrument for hours without evidence of curling of its edges or other damage.

The projection lens is mounted above the other members of the optical system on two slender vertical metal tubes which furnish little or no obstruction to the view of the audience (Fig. 4). The tubes slide vertically on rods and are balanced by sash springs which permit easy adjustment for sharp focus of the image. Mounted above the projection lens, at an angle of about 45°, is a first surface mirror. This is arranged so that its inclination can be adjusted with the fingertips to place the projected image in the desired location on the projection screen.

There are several interesting and novel features in this instrument worthy of emphasis. The use of ectar lenses for projection of x-ray films is contrary to the theories held by some projection engineers. They generally have felt that the relatively poor definition of such films does not warrant use of a lens of so high a quality. This is not borne out by the experience of the authors. The detail seen in the projected image sometimes actually exceeds that seen in the same film viewed with a conventional illuminator. This is particularly true of underexposed films.

The liquid condenser lenses are somewhat of an innovation, although they have been used at various times in photoengraving. Sometimes, after continuous use for a fairly long period, convection currents due to unequal heating of the oil in the lower lens cause mildly annoying streaks to appear on the projected image. This may be hardly noticeable. The authors are at present considering whether the nuisance is sufficiently great to warrant the effort and expense to dispel the convection streaks. On the other hand, the liquid lenses absorb much less of the useful light than do glass ones. They also produce no color around the edges of the image, which conventional glass lenses do.

Another simple and somewhat revolutionary feature is the use of the reflector type of light source. The film projectors heretofore commercially available use concentrated filament lamps which require an expensive, cumbersome, bulky, and complicated cooling system in order to dissipate the tremendous quantities of heat produced. Moreover, the filament of such a lamp casts a shadow which to some extent breaks the continuity of the light beam, making less of the actual light available for useful purposes.

The new light source is a paraboloid reflector and for the most part is actually in front of the lamp filament. It fills up a

considerable portion of the projection lens, giving as much useful light as a 2,000-watt conventional lamp; four times the actual wattage, with hardly any of the heat. Moreover, it emits a greater proportion of visible light in proportion to the heat, producing a more pleasant light for the eye because of its extreme whiteness.

SUMMARY

1. A new instrument capable of projecting all sizes of conventional roentgenograms, and fulfilling most of the criteria desirable in such an apparatus, has been described.

2. Some of its component parts have been developed from war-surplus material.

3. Several novel features are introduced consisting of "liquid" condenser lenses and a light source requiring no cooling system.

NOTE: Acknowledgment is made, with thanks, to Mr. A. Muscat of the hospital Maintenance Department for assistance in assembling the original pilot-model of the projector.

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ADDENDUM

Since this paper was accepted for publication, the authors have devised and put into use oil reservoirs for the condenser lenses. As a result, the off-horizontal setting of the lenses in their plywood seats is no longer necessary. Each liquid lens is now a complete unit, and no concern for expansion or overflow need be considered.

The authors have also devised a new portable model of the projector which permits easy and quick assembly and disassembly of the unit into three easily carried parts.

SUMARIO

Nuevo Proyector de Películas para Radiografías Originales de Tamaño Completo

El nuevo instrumento descrito está destinado a la proyección de radiografías corrientes de todo tamaño. Construído en forma sencillísima, cumple la mayor parte de los requisitos buscados en un instrumento de ese género. Características propias son el empleo de lentes de condensador "líquido" y foco luminoso en forma de reflector paraboloideo que emite tanta luz útil como una lámpara corriente de 2,000 vatios, sin apenas producir el calor de ésta.

Radiation Doses from Diagnostic X-Ray Studies[1]

JOHN S. HANDLOSER and ROBERT A. LOVE, M.D.

Brookhaven National Laboratory

THE AVERAGE PERSON experiences no significant hazard from roentgen examinations, but in workers handling radioactive materials, such x-ray exposure may produce an excessive cumulative effect. Because the maximum permissible exposure at Brookhaven National Laboratory is 0.3 r per week total body radiation, it seemed desirable to determine the exposure for different types of diagnostic x-ray procedure. A search of the literature revealed insufficient data upon which to base expected radiation exposures (1–5). The x-ray apparatus[2] used by the Medical Department had, therefore, to be calibrated. This report deals with the methods of measurement and the results.

A Victoreen condenser r meter, number 2557, and 10- and 0.25-r chambers were used for calibrating. The 0.25-r chamber had been tested previously with the use of a standard radium gamma source and was found accurate to within 1 per cent of full scale. This chamber was used for all measurements except those made on the photofluoroscopic unit and the fluoroscopic unit, for which the 10-r chamber was used. Two corrections were made for each measurement. One, the barometric and temperature correction, was made in accordance with the tables supplied with the instrument. The second correction, concerned with the response of the r meter at soft x-ray frequencies, was made according to F. Day (6) and ranged between 1 and 10 per cent. Since the response of the r meter at low-kilovoltage potentials drops off, the correction factor was estimated finally after further personal correspondence with Day.

A paraffin phantom was used in these measurements and the target-chamber distance in each case was equivalent to the target-skin distance. The phantom was a rectangular box having a base 25 × 30 cm. and a height of 19 cm., which approximates the thickness of a patient. The data were plotted as constant milliampere curves, with the kilovoltage and skin dose-rate in roentgens per second as the variables. Figure 1 shows the results of the measurements from 30 to 100 kv. Table II shows the exposure received from some common diagnostic examinations.

TABLE I: X-RAY TUBE DATA

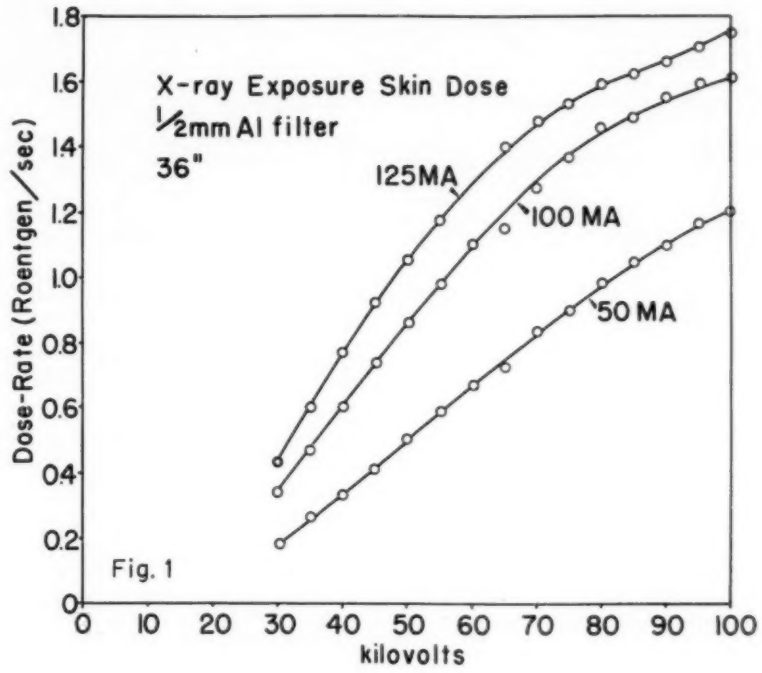
	Use	Tube Type	Style No.	Serial No.
1.	Photofluoroscopic unit	Dynamax 25	WHA-S AA	9911
2.	Fluoroscopic unit			
	Above table	Dynamax 25	981625	12168
	Below table	Dynamax 25	981625	12136
3.	Diagnostic films	Dynamax 25	981625	12173

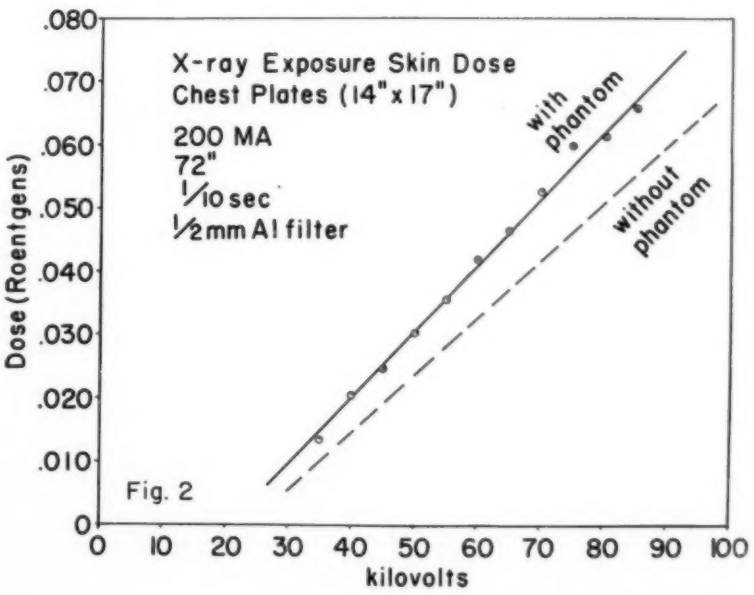
The dose received from the photofluoroscopic unit used varies with the size of the patient, because the time of exposure is controlled by a phototimer. This accounts for the wide range in the dose delivered by this unit. In the technic used for the 14 × 17-inch chest films on employees exposed to ionizing radiation, the exposures were made at 6 feet, the instrument set at 200 ma., with an exposure time of one-tenth second, and with a filter of 0.5 mm. of aluminum in the beam. Thus the only variable between patients is the kilovoltage. Figure 2 shows the dependence of the skin dose on this factor. The broken curve of Figure 2 shows the dose measured without the phantom.

In measuring the dose received from the fluoroscopic unit, the 10-r chamber was placed on the table on which the patient

[1] Research carried out under the auspices of the U. S. Atomic Energy Commission. Accepted for publication in November 1950.

[2] Westinghouse Electric Corporation (see Table I).





lies and the phantom was placed over the chamber. The dose rate was found to be 0.28 r per second with the instrument set at 5 ma. and 75 kv.

In similar studies, other authors obtained results comparable to these presented here, even though different equipment was used. In the two large diagnostic

TABLE II: EXPOSURES INCIDENT TO SOME COMMON DIAGNOSTIC PROCEDURES
(All exposures made with 0.5 mm. Al as a filter)

	Kv.	Ma.	Time (sec.)	Distance (in.)	Approximate Dose (roentgens)
Chest, postero-anterior (14 × 17-inch film)	72	200	1/10	72	0.05
Chest, postero-anterior (photofluoroscopic)					0.7 to 1.2
Lumbar spine, anteroposterior	55	100	1 1/2	36	1.5
Lumbar spine, lateral	78	50	6	36	5.7
Pelvis	60	100	1	36	1.1
Pregnancy, anteroposterior	67	125	2	30	3.6
Pregnancy, lateral	78	50	6	30	9.0
Kidney-ureter-bladder	62	100	1	36	1.2
Abdomen	68	100	1	36	1.3
Gastro-intestinal series (stomach, postero-anterior), per film*	78	125	2/5	36	0.65
Gastro-intestinal series (total of six films*)			Same		4.0
Gallbladder	74	125	2/5	36	0.60
Extremities	50	50	1/2	36	0.25
Extremities	45	50	2	36	1.0
Skull, postero-anterior	54	100	1 1/2	36	1.3
Skull, lateral	54	100	1 1/2	36	1.3
Fluoroscopy	75	5		As close as possible	0.28/sec.

* Doses for gastro-intestinal series do not include the accompanying fluoroscopy.

x-ray machine installations at Brookhaven National Laboratory, no appreciable difference was found in the dose delivered to the patients.

SUMMARY

For persons exposed to radiation in the course of their work it is desirable to know radiation exposures resulting from common roentgenological practices even though these do not represent total body irradiations. Values for the different types of diagnostic roentgenograms with the machines used at Brookhaven National Laboratory are recorded.

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SUMARIO

Dosis de Radiación Derivadas de los Estudios Diagnósticos con Rayos X

La mayoría de los enfermos no experimentan mayor riesgo derivado de los exámenes diagnósticos con los rayos X, pero en los técnicos que manipulan sustancias radioactivas esa exposición adicional puede producir un efecto acumulativo excesivo. Por esta razón conviene conocer las exposiciones debidas a los procedimientos corrientes de diagnóstico radiológico, aun cuando no representan irradiación total del cuerpo. Esas exposiciones fueron determinadas con los aparatos usados en el Laboratorio Nacional de Brookhaven, variando, según se observó, de 0.05 r para una radiografía postero-anterior de 35 × 42.5 cm. del tórax a 9.0 r para una vista lateral del útero grávido.

EDITORIAL

Two-Million-Volt Radiation

Supervoltage radiation in the form of two-million-volt roentgen rays, when the quality of radiation delivered is comparable to the quality of the radium beam, has given us our first opportunity to study and evaluate what might be accomplished by a radium bomb of a magnitude of 5,000 gm., providing that much radium were available in the world. In addition to having a quality equivalent to radium-bomb radiation, supervoltage roentgen radiation has several advantages, even if radium were ever found in quantities sufficient for bombs of this magnitude. To begin with, it allows complete shielding for those working with it, without danger of even small amounts of radiation reaching personnel. Radiation delivered by this means, moreover, is developed from a point source, which means that a small tumor can be treated with a sharply defined field. The ease of maneuverability of the equipment is such that treatment may be delivered through ports of special size and shape without endangering either patient or personnel.

Studies on tissue effects have shown that the best quality beam for irradiation of tumors, when bone must receive radiation concomitantly, is between two- and ten-million volts. With voltages lower than this, bone absorption is increased, resulting in a greater radiation effect in bone than is best for ideal treatment, while with more than ten million volts, ionization from pair production produces the same effect in bone. Since most malignant lesions are so located that considerable bone must be treated, it is probable that this will become an important consideration in the successful approach to treatment.

During the past two years it has been our privilege to treat several hundred cancer patients at Massachusetts Institute of Technology, using the equipment developed by Dr. John Trump and associates. During this period, another several hundred patients have been treated, with a quality of radiation in the order of a half-value layer of 2 mm. of copper to a half-value layer of 3.3 mm. of copper. The reactions of the patients to treatment with 2 mev radiation have been sufficiently different to warrant an opinion concerning the normal soft-tissue reactions, even though the time of observation has been short.

In the management of the cancer patient it is our duty, whenever possible, to make the decision as to whether the treatment to be delivered is to be of a palliative nature or whether an attempt is to be made to cure the disease. It is important, if palliation is the object, that we deliver radiation in doses large enough to control pain and discomfort as well as to prolong life, but not in large enough quantities to produce discomfort which may make the patient worse rather than better. A great deal of the value of palliative treatment depends upon the type of tumor and condition of the patient both psychologically and physically, but no small part is dependent upon the physician. It becomes a different problem when we decide, after careful evaluation, that the lesion is curable. In these cases a sufficient quantity must be delivered within a period of time to destroy the malignant tissue without undue injury to normal tissue. It is apparent, then, that in the curable case a type of radiation should be used which will allow us to treat not only the primary tumor but its lymphatic drainage as well. In order to destroy all cells, the region must be treated homogeneously. While doing this, every

effort must be made to prevent radiation sickness and to keep the patient in good general condition during and following treatment.

The immediate reaction to the treatment received is important. If radiation sickness sets in, it is a detriment to the carrying out of proper treatment and, in addition, it has a bad effect psychologically on the patient. The tolerance of patients who receive two-million-volt x-ray therapy with a half-value layer of 13 mm. of copper is definitely better than that of the patient who is treated with radiation in the order of a half-value layer of 2.0 to 2.5 or even 3.0 mm. of copper. It is, indeed, unusual, with supervoltage therapy, for medication to be required for radiation sickness, except occasionally when treatment is delivered over the upper gastro-intestinal tract. We have successfully treated the entire liver without radiation sickness during or following treatment. Everyone is familiar with the inability to treat this region with conventional high-voltage radiation.

No single drug has been able to control radiation sickness completely, but we have found, as Dr. George Holmes stated some twenty-five years ago, that glucose in readily available quantities is an adjunct to radiation therapy, especially if the patient is nauseated and vomiting; intravenous glucose will usually control symptoms within a short period of time. For convenience and for psychologic reasons, in most cases we use drugs such as pyridoxine hydrochloride, 40 mg. daily, or one of the antihistamines, 50 mg. or equivalent every six hours. Fortunately, few cases of radiation sickness have been severe enough to require discontinuance of treatment. In all such cases, diffuse metastases were found over the small and large bowel, such as are seen in cases of carcinoma of the ovary.

The protection of normal tissue and the delivering of a tumor dose to abnormal tissue are perhaps our most important functions and it is here that a marked difference can be noted in the immediate and late effects of supervoltage radiation. These effects have been markedly different, in that we have found that normal tissues tolerate 6,000 and 7,000 r without difficulty, even when large portals are used and treatment is directed to both sides of the neck, both supraclavicular regions, both infraclavicular regions, and to the mediastinum. If an attempt were made to treat comparable amounts of normal tissue with conventional radiation apparatus daily, the skin reaction would indeed be severe and, according to our figures, in many cases would make treatment impossible.

It is apparent from our work that supervoltage therapy allows us to treat tumors, whether deep or superficial, and to deliver a dose of 6,000 r into the tumor tissue in approximately thirty-five treatment days without undue changes, late or early, in normal tissue. Supervoltage treatment also permits us for the first time to include adequately in the treatment fields the areas of lymphatic drainage.

The development of supervoltage treatment has created many new problems within the radiology department, since success depends not only on a knowledge of cancer but on the advice and assistance of a well trained medical radiation physicist. It appears likely that the treatment of cancer is being developed along scientific lines which may allow us to separate the curable cases from those in which only palliation is possible and, when opportunity arises for cure, to administer treatment accurately and adequately on a scientific basis.

HUGH F. HARE, M.D.
Lahey Clinic, Boston, Mass.

OLIVER HOWARD McCANDLESS

1876–1951

Oliver Howard McCandless, first president of the Radiological Society of North America, died May 2, 1951, at Independence, Mo. Dr. McCandless was born on March 24, 1876, at Greenwood, Jackson County, Missouri, the son of Robert Wilson McCandless, M.D., and Pharaby Gregg McCandless, of Scotch-English ancestry, and was reared and educated in the Middle West. His premedical education included attendance at Emporia College, and there, as a student, he first had contact with the infant science of radiology, when in May 1896 he assisted the county coroner in attempting his first x-ray "picture."

Graduating in medicine from the University Medical College of Kansas City, Mo., in March 1901, Dr. McCandless first practised medicine in Emporia, Kans. On May 1, 1902, he entered the field of radiology, becoming assistant to J. N. Scott, M.D., pioneer radiologist of Kansas City. Soon after this association Dr. Scott became incapacitated through exposure to roentgen rays, and as early as 1904 Dr. McCandless was himself showing signs of

damage to his hands and arms, and in particular to his right index finger. This necessitated the first of several periods away from exposure to roentgen rays and the practice of radiology.

Returning to practice in 1905, Dr. McCandless opened an office in the Argyle Building, Kansas City, then not wholly completed, which he maintained until 1946. He was appointed Professor of Radiology in the University Medical College in 1905, and served in that capacity until the college was amalgamated with the University of Kansas Medical School. He became a member of the American Roentgen Ray Society in 1902 and soon afterward of the Kansas City Academy of Medicine. For fifty years a member of the Jackson County Medical Society and the Missouri State Medical Society, he was active in organizational work of medicine and radiology and was in frequent attendance at local, regional, and national meetings between 1905 and 1922. He read numerous papers at national medical gatherings and was frequently invited to discuss papers presented by others.

A second period of enforced temporary retirement from the active practice of radiology came during the winter of 1908–1909, because of excessive exposure to roentgen rays incident to a thriving practice. Fortunately Dr. McCandless was able to return to active practice in the latter part of 1909 and to continue until 1925, when because of further impairment of health he went into semi-retirement, continuing his office with the aid of associates and devoting much of his time to phases of medicine other than radiology. Resuming active practice in 1938, he served as radiologist to the Independence Sanitarium and Hospital, Independence, Mo., as well as maintaining his own office, until February 1946.

Elected in 1917 as a member of the Western Roentgen Society, the forerunner of the Radiological Society of North America, Dr. McCandless became the first president of the latter organization in 1919. He was president of the Roentgen Section of the Southern Medical Society for six years, beginning in 1919, and was also chancellor of that society for the State of Missouri. He held memberships and honorary memberships in a number of other medical organizations.

Though he volunteered early for active military service in World War I, Dr. McCandless was rejected because of a heart lesion. He was later cited for outstanding service, however, by the American Red Cross.

Early to observe the effects of exposure to x-rays on himself and on a score of personal friends, pioneers in radiology, whom he saw die untimely deaths, martyrs to the roentgen ray, Dr. McCandless regulated his career so that he had a long and useful life, though not escaping certain permanent damage from his early exposure, necessitating the amputation of some of his fingers. Always thorough in recording his observations and maintaining detailed records on his patients, he left his unpublished memoirs, from which the writer has been privileged to gather some of the facts recorded here.

A gentleman and a scholar, Oliver H. McCandless maintained a keen interest in medicine in general and radiology in particular until his death. His interests were many and he carried on an active life until his final illness. The first to diagnose this as carcinoma of the stomach with metastases to the liver, he maintained a serenity and a ready wit until the end.

Dr. McCandless is survived by his widow, Mrs. Ethel McCandless, of Independence, Mo.

A pioneer in radiology has left our midst, we have lost our first president, and those of us who have been privileged to know and love him mourn the loss of a steadfast friend.

JOHN F. BOWSER, M.D.

MORTON HELPER, M.D.

1912–1951

Dr. Morton Helper died at the University Hospital in Columbus, Ohio, on May 10, 1951, at thirty-nine years of age. His death is a regrettable loss to the medical fraternity of Evansville, Ind., and to the community in general.

Dr. Helper was an alumnus of the University of Michigan, where he received the degree of Bachelor of Science in 1932, Doctor of Medicine in 1936, and Master of Science in Radiology in 1938. He was a member of the honorary society of Alpha Omega Alpha. After an internship at Harper Hospital in Detroit, he returned to the University of Michigan to take formal training in radiology, which was completed in 1940. He then continued at the University for an additional year as instructor in radiology. He was certified by the American Board of Radiology as a specialist in radiology in 1940.

Private practice in his specialty was begun by Dr. Helper in Evansville, Ind., in 1941, but was interrupted from September 1942 until February 1946 by military service. He served with distinction in Hawaii, Leyte, and Japan, was awarded the Bronze Star, and attained the grade of Major. Upon expiration of the national emergency, he returned to his practice in Evansville.

Dr. Helper diagnosed his own illness of Hodgkin's disease from chest roentgenograms made in his laboratory in 1948. The disease was well controlled for more than two years, and during that time its existence was not suspected by a host of friends and acquaintances. Late in the summer of 1950, he began to have distressing symptoms, but he continued to exercise professional service in undiminished measure and skill until March 12, 1951.

Morton Helper, M.D.

Dr. Helper was a member of the American College of Radiology, Radiological Society of North America, the Indiana Roentgen Ray Society, and the American Medical Association. At the time of his death he was one of the officers of the Vanderburgh County Medical Society.

A. A. HOBBS, JR., M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

SEVENTH INTERNATIONAL CONGRESS OF RADIOLOGY COPENHAGEN, 1953

In accordance with the decision of the International Committee of Radiology which met in London in July 1950, the Seventh International Congress of Radiology will take place in Copenhagen in 1953. The dates will be July 19–25.

The officers for the Congress are as follows: *Honorary President*, Prof. Niels Bohr; *President*, Prof. P. Flemming Møller; *Vice-Presidents*, Dr. Sv. A. Chrom (Diagnosis), Dr. Jens Nielsen (Therapy), Prof. Carl Krebs (Biology), Prof. H. M. Hansen (Physics), Dr. E. de Fine Licht (Technical Section and Exhibition); *Treasurer*, Mr. Aage von Benzon; *Secretary-General*, Prof. Flemming Nørgaard.

Radiologists from throughout the world will be welcome at the Congress. All national radiological societies are being asked to supply a list of their members, and full details about registration for the Congress, as soon as they are available, will be sent to all radiologists individually.

Correspondence should be addressed to the Congress Office at 10 Øster Voldgade, Copenhagen K.

FLEMMING NØRGAARD
Secretary-General

FOURTH INTER-AMERICAN CONGRESS OF RADIOLOGY

The meeting place of the Fourth Inter-American Congress of Radiology will be Mexico City, and the date will be Nov. 2–6, 1952. The officers of the Congress are as given in RADIOLOGY for July 1950.

AMERICAN RADIUM SOCIETY

At the Thirty-third Annual Meeting of the American Radium Society held in Atlantic City, N. J., June 7–9, the following officers were elected for the year 1951–52: President, Hugh F. Hare, M.D., Boston, Mass.; President-Elect, Howard B. Hunt, M.D., Omaha, Nebr.; First Vice-President, Edith H. Quimby, Sc.D., New York; Second Vice-President, Theodore R. Miller, M.D., New York; Secretary, John E. Wirth, M.D., Pasadena, Calif. (re-elected); Treasurer, Grant H. Beckstrand, M.D., Long Beach, Calif. (re-elected).

CLEVELAND RADIOLOGICAL SOCIETY

The newly elected officers of the Cleveland Radiological Society are Dr. John R. Hannan, President, and Dr. Mortimer Lubert, Heights Medical Center Bldg., Cleveland Heights 6, Secretary-Treasurer.

NEW YORK ROENTGEN SOCIETY

The following recently elected officers of the New York Roentgen Society assumed office on Sept. 1: Maurice Lenz, M.D., President; John L. Olpp, M.D., Vice-President; Irving Schwartz, M.D., 45 East 66th St., New York 21, Secretary; Ernest H. Wood, M.D., Treasurer.

SAN FRANCISCO RADIOLOGICAL SOCIETY

The San Francisco Radiological Society, organized in May 1951, elected as its officers A. J. Williams, M.D., President; A. A. de Lorimier, M.D., President-Elect; Ivan J. Miller, M.D., 2680 Ocean Ave., San Francisco 27, Secretary-Treasurer. The Society will meet quarterly.

TENNESSEE RADIOLOGICAL SOCIETY

The newly elected officers of the Tennessee Radiological Society are Dr. Walter D. Hankins, Johnson City, President; Dr. J. E. Whiteleather, Memphis, Vice-President; Dr. J. Marsh Frère, Newell Hospital, Chattanooga 2, Secretary-Treasurer.

CANCER SEMINAR PENROSE CANCER HOSPITAL

The yearly Cancer Seminar sponsored by the Penrose Cancer Hospital will be held at the Broadmoor Hotel in Colorado Springs on Sept. 8, 1951. This year the Seminar will be devoted to 15 cases of mediastinal and pulmonary lesions. Photographic copies of the roentgenograms and clinical summaries of these cases will be sent to the participating radiologists. Histopathologic slides of the same cases and their clinical summaries will be sent to the participating pathologists. Philip J. Hodes, M.D., Professor of Radiology, University of Pennsylvania, and Arthur P. Stout, M.D., Associate Professor of Surgical Pathology, Columbia University, will be the guest speakers. L. Henry Garland, M.D., Clinical Professor of Radiology, Stanford University, will take part in the Seminar and will be the banquet speaker. Cases will be discussed in succession, with audience participation. The proceedings of the Cancer Seminar will be recorded and later edited and published, as in preceding years. Those desiring to attend may write to James W. McMullen, M.D., Penrose Cancer Hospital, Colorado Springs, Colo.

CONTINUATION COURSE IN ROENTGENOLOGY OF CHEST DISEASES

The University of Minnesota announces a continuation course in Roentgenology of Chest Diseases to be presented at the Center for Continuation Study

from Oct. 29 to Nov. 3, 1951. The course will include detailed anatomical and pathological studies of the chest presented by means of lectures and demonstrations. Correlation of this material with clinical and roentgen findings will be emphasized. Visiting faculty members of the course include Dr. W. Edward Chamberlain, Temple University, Philadelphia; Dr. Benjamin Felson, University of Cincinnati; Dr. L. Henry Garland, Stanford University, San Francisco; Dr. George R. Krause, Mount Sinai Hospital, Cleveland; and Dr. Averill A. Liebow, Yale University, New Haven.

Dr. Chamberlain will give the annual Leo G. Rigler Lecture in Radiology on the evening of Thursday, Nov. 1. Chairman for the course will be Dr. Rigler, Professor and Head of the Department of Radiology. He will be joined by the members of the faculty of the University of Minnesota Medical School and the Mayo Foundation.

REPORT OF COMMITTEE OF MINNESOTA STATE RADIOLOGICAL SOCIETY FOR HOSPITAL ADMISSION CHEST EXAMINATION

The following Report, presented by the Committee of the Minnesota State Radiological Society for Hospital Admission Chest Examination, at the annual meeting of the Society in Rochester, May 1, 1951, and unanimously adopted, is reprinted here because of its interest to radiologists everywhere.

I. Hospital admission chest examinations are highly desirable as a public health measure and as a protective measure against the spread of tuberculosis to hospital personnel and other hospital occupants.

II. Members of this Society are urged to promote this procedure in all hospitals with which they are associated and to that end should solicit the aid and co-operation of the individual hospital administrations, the staff of the hospital, and especially the staff most directly concerned with diseases of the chest.

III. Your Committee recognizes that the wide variations in hospitals as to location, size, specialization, financial status, availability of radiological staff and equipment, and availability of adequate space, make it impossible to recommend a uniform program for all hospitals. With this in mind, the Committee makes the following recommendations:

(*a*) The taking and reading of chest films and photofluorograms should be entirely under the jurisdiction of the Roentgen Department of the Hospital. The follow-up work belongs under the supervision of the attending physician.

(*b*) The taking, processing, reading, and reporting of chest films or photofluorograms should be carried out within twenty-four hours of admission of the patient. The follow-up medical staff should receive and review all positive reports before filing and should at once institute necessary follow-up procedures.

(*c*) Both the roentgenologist and the attending physician should assume the responsibility that all adult admissions are submitted to the examination.

(*d*) The lower age limit of patients to be included in the study should be determined by the staff. It is recommended that this age limit should be the sixteenth birthday, but it may be set at a lower age at the discretion of the staff.

(*e*) Smaller hospitals, possibly up to 150 or 200 adult-bed capacity, could justifiably use 14 × 17-inch films made in the established Roentgen Department. Since most admissions are in the afternoon and evening hours, this should be feasible without undue delay of the other admission routine. The 14 × 17-inch film should be treated as a diagnostic study and not only a study for "detection of pathology."

(*f*) In larger institutions photofluorography would be more feasible and may be highly desirable. The following detailed recommendations are made regarding photofluorography:

1. The photofluorography equipment should be installed in the admitting department. Any compromise with this recommendation will, in direct proportion to the adjustment made, compromise the efficiency and adequacy of the program.

2. The technical staff should consist of members of the technical staff of the Roentgen Department, who may be rotated through the admitting department. Any concessions in this matter likewise will compromise the results.

3. The photofluorographic equipment should be the best obtainable with the funds available. The choice of equipment should rest with the radiologist of the hospital concerned.

4. The exposures may be made with or without the removal of the patient's clothing. This should be decided by the individual radiologist who reads the films.

5. The emergency technician of the Roentgen Department should be available for call at all hours so that the service is available on a twenty-four-hour basis.

6. All patients not submitted to photofluorography on admission should be examined within twenty-four hours, either by return to the photofluorographic unit, or by 14 × 17 film in the Roentgen Department, or at the bedside.

IV. Your Committee recognizes the fact that such a program of Hospital Admission Chest Examinations, if done correctly, is time-consuming and places a not inconsiderable burden and responsibility on the roentgenologist. The Committee believes the radiologist should be compensated just as any other physician practising his profession. In this stand the Committee follows the advice of the American College of Radiology (*Monthly News Letter*, October 1949). This position is also supported by a quotation from a letter dated Nov. 1, 1946, of H. V. Hullerman, M.D., Ass't. Director of

the American Hospital Association, to Dr. E. S. Mariette, as follows: "The National Association has made no recommendation with respect to charges or methods of paying radiologists, recognizing this is a matter of concern to the individual hospital and radiologist. Presumably, the same principle that applies to all radiology service will guide the development of charges and payments in mass radiography programs. These principles are based upon the idea that there should not be exploitation by the hospital, patient, or radiologist, and the procedures should be such as to provide the greatest possible x-ray service consistent with the patient's needs."

We, therefore, make the following recommendations:

(*a*) A charge labeled "Admission Examination" should be made against every adult admission to the hospital who is so examined.

(*b*) Such charges should be credited to the accounts of the Roentgen Department.

(*c*) Where a 14 × 17-inch film is used for the examination, a charge of not less than $4.00 should be made.

(*d*) Where photofluorographic examination is made, the charge is to be not less than $1.50, the charge to be determined by the individual hospital and its roentgenologist, keeping in mind the total expense of the examination, including remuneration of the roentgenologist.

(*e*) A follow-up single 14 × 17-inch film examination should bear the usual charge for this examination in addition to the charge made for photofluorography.

(*f*) It is assumed that these charges include a sufficient margin above cost of production to provide remuneration for roentgenologic supervision of the program. It is also assumed that the details of the program will have to be determined individually in every hospital by the co-operative effort of the administration and the roentgenologist.

V. Finally, your Committee respectfully submits that emphasis be placed on the quality of the work done, rather than on minimal expense and minimal personal effort.

Respectfully submitted,
C. B. NESSA, M.D.
WALTER H. UDE, M.D.
STANLEY C. PETERSON, M.D.
A. L. ABRAHAM, M.D.
J. P. MEDELMAN, M.D., *Chairman*

BERTNER FOUNDATION AWARD

Dr. Fred W. Stewart, Pathologist for the Memorial Hospital Center for Cancer and Allied Diseases, New York City, and editor of *Cancer*, was the recipient of the 1951 annual Bertner Foundation Award, and delivered the Bertner Lecture at the University of Texas M. D. Anderson Hospital's Fifth Annual Symposium on Fundamental Cancer Research at the Shamrock Hotel in Houston on April 21. Established in 1950, the Bertner Award and Lectureship are given each year in recognition of outstanding contributions to the field of cancer research.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

VISCERAL RADIOLOGY. By EMERIK MARKOVITS, M.D., Formerly, Scientific Collaborator of the Central Radiologic Institute of the General Hospital (Holzknecht-Institute), Vienna; Head of the Radiologic Department of Elizabeth Hospital of the City of Budapest; Post-graduate Lecturer at the Central Radiologic Institute of the University of Budapest; Radiologist of the Steiner Cancer Clinic, Atlanta, Ga. A volume of 612 pages, with 682 illustrations. Published by The Macmillan Co. New York, 1951. Price $24.00.

LE SYNDROME DE MORGAGNI-MOREL: ÉTUDE ANATOMO-CLINIQUE. HYPEROSTOSE FRONTALE INTERNE, ADIPOSITÉ, VIRILISME ET TROUBLES NEURO-PHYSCHIQUES. By ANDRÉ CALAME, Institut de Pathologie de Genève. With preface by Dr. E. Rutishauser, Professeur à la Faculté de Médecine de Genève. A volume of 154 pages, with 27 illustrations. Published by Masson et Cie, Paris, 1951. Price 700 fr.

Book Reviews

THE ABNORMAL PNEUMOENCEPHALOGRAM. By LEO M. DAVIDOFF, M.D., Director of Neurological Surgery, Beth Israel Hospital, New York City; Clinical Professor of Neurosurgery, New York University Postgraduate Medical School, and BERNARD S. EPSTEIN, M.D., Associate Radiologist, The Jewish Hospital of Brooklyn, Brooklyn, N. Y., and Instructor in Clinical Radiology, Long Island College of Medicine. A volume of 506 pages, with 695 illustrations. Published by Lea & Febiger, Philadelphia, 1950. Price $15.00.

For many years, specifically since the publication in 1937 of the first edition of *The Normal Encephalogram* by Dr. Leo M. Davidoff and the late Dr. C. G. Dyke, there has been a demand by radiologists and workers in the field of neuropathology for a companion volume depicting the abnormal findings demonstrable on the encephalogram. Through the joint efforts of Dr. Davidoff and Dr. Bernard S. Epstein, this demand has at last been met.

The contents of the new work are arranged in two main parts, dealing respectively with tumors and

non-tumorous lesions of the brain. About 60 per cent of the book is devoted to true brain tumors. As a background for this study the authors have included a chapter on pathology. While this makes no pretense at providing a complete pathological description of the various types of neoplasm that may be found within the cranial cavity, it does serve to inform the roentgenologist, "in a general way, at least," about their essential characteristics. The remaining chapters of Section 1 describe the tumors occurring in various anatomic locations in the brain and associated structures. A uniform plan of presentation is observed in these chapters: a general introduction is followed by a review of the literature, a detailed account of the authors' own material, and a consideration of differential diagnosis.

A similar plan has been employed in Section 2 of Part 1, which takes up, in order, chronic subdural hematoma, brain abscess, syphilis of the brain, vascular anomalies, intracranial aneurysms, and cerebral hemorrhage and thrombosis.

Part 2 consists of eleven chapters devoted to non-tumorous lesions affecting the brain and surrounding structures, as congenital anomalies, infections, and degenerative diseases. Many associated skull lesions are included. The general plan of the text is much the same as in the earlier chapters.

The book is well illustrated with many photographs of the gross lesions and roentgenograms depicting the characteristic encephalographic findings. The text is clearly written and well documented as to sources of information. An excellent bibliography and a good index are appended.

It may be repeated that this volume is an answer to the wishes of many workers in the special field with which it deals. Its value to the radiologist, neurologist, and neurosurgeon is inestimable.

THE NORMAL ENCEPHALOGRAM. By LEO M. DAVIDOFF, M.D., Director of Neurological Surgery, Beth Israel Hospital, New York City; Clinical Professor of Neurosurgery, New York University Postgraduate Medical School, and CORNELIUS G. DYKE, M.D., Late Associate Professor of Radiology in the College of Physicians and Surgeons, Columbia University; Late Director in the Department of Radiology of the Neurological Institute of New York, New York City. A volume of 240 pages, with 190 illustrations. Third edition, thoroughly revised by LEO M. DAVIDOFF, M.D. Published by Lea & Febiger, Philadelphia, 1951. Price $6.00.

The completion of *The Abnormal Encephalogram* (see preceding review) as a companion to Davidoff and Dyke's *The Normal Encephalogram* found the second edition of the latter work exhausted. A third edition has therefore been prepared by the surviving author, Dr. Davidoff, who has revised and brought up to date the preceding edition by the addition of current knowledge in this field, new illustrations, and more recent references to the literature. The companion volumes will prove invaluable to the student of roentgenology or neurology and to all who practise either specialty.

The text of *The Normal Encephalogram* is divided into five chapters. Chapter 1 is devoted to the indications for and technic of encephalography, including also an explanation of certain untoward reactions to the procedure, a description of its general modus operandi, and a brief mention of its therapeutic aspects as reported by others. The remaining chapters describe the normal brain anatomy as delineated by the introduction of air. Chapter 2 deals with the ventricles, interventricular foramina, and the aqueduct; Chapter 3 with the cerebral convolutions and sulci; Chapter 4 with the subarachnoid cisterns; Chapter 5 with the intracranial structures and their related fluid spaces.

The material assembled here represents a very large experience extending over many years and reflects a wide knowledge of the subject. In their description of the normal and near-normal intracranial structures as portrayed encephalographically, the present author and his former associate have done an incomparable job.

The book is nicely printed and well bound. The revised bibliography covers thirteen pages.

LEHRBUCH DER RÖNTGENDIAGNOSTIK. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, E. UEHLINGER, with contributions by E. BRANDENBERGER, A. BRUNNER, U. COCCHI, N. P. G. EDLING, J. EGGERT, F. K. FISCHER, M. HOLZMANN, H. KRAYDENBÜHL, Å. LINDBOM, E. LINDGREN, G. A. PREISS, S. WELIN, AND A. ZUPPINGER, Vol. 1. The Skeletal System. Part IV. A volume of 513 pages, with 674 illustrations. Published by Georg Thieme, Stuttgart, 5th completely revised edition, 1951. Sole distributors for the U. S. A. and Canada: Grune and Stratton, Inc., 381 Fourth Ave., New York 16, N. Y.

Six chapters, lettered S to X, comprise Part IV and complete Volume I of the Fifth Edition of this outstanding work. They conclude the presentation of the x-ray diagnosis of the skeletal system.

S. The Spinal Column. A discussion of the fundamentals of development and weight bearing serves as an admirable introduction to the roentgen findings in related pathologic processes. Myelograms illustrate the use of three contrast media: radiopaque oil, water-soluble dye, and air.

T. The Skull. A description of the normal anatomy and a consideration of the signs of disease as seen on routine skull films open the chapter. There follow sections on ventriculography, encephalography, and cerebral angiography. The paranasal sinuses, temporal bone, orbit, mandible, and teeth have appropriate space allotments. Localization of foreign bodies in the orbit is limited in discussion to European methods. The Sweet method, so popular in America, is not mentioned.

U. Muscles, Tendons, Subcutaneous Tissue, Vessels, Breast, and Salivary Glands. This section forms a catch-all for such unrelated soft-tissue findings as calcinosis, peritendinitis calcarea, myositis ossificans, lipomata, and cysticercosis. Paragraphs dealing with fistulous tracts, venography, arteriography, and glandulography are also included.

V. Foreign Body Localization. While the sundry geometric tricks that are so widely used are not omitted, it is pleasant to find the often neglected needle method given pre-eminence. On page 1850 one reads: "(Fluoroscopic) harpooning is the simplest and oldest method (of foreign body localization)."

W. Differential Diagnosis of Skeletal Disease. Forty-eight pen-and-ink sketches of the full skeleton illustrate as many generalized diseases. A table summarizing 69 entities supplements the sketches.

X. Roentgen Sketches from a Topographic Point of View. While Section W attacks roentgen nosology in terms of disease process, Section X offers a classification on the basis of anatomic location. Over 300 small drawings supplement thumbnail write-ups of the disorders apt, on the basis of probability, to be found in various parts of the body such as the skull, knee, elbow, hip, and shoulder.

CONFRONTATIONS RADIO-ANATOMO-CLINIQUES. Fascicule IV. Published under the direction of M. CHIRAY, R. A. GUTMANN, AND J. SÉNÈQUE. A volume of 68 pages, with 127 illustrations. Published by Masson et Cie, Paris, 1951. Price 1250 fr.

This monograph is similar to previous *Confrontations* published by the same group in that a number of interesting cases are presented as a series of reports. The following are perhaps typical.

One patient developed a herniation of the stomach through the diaphragm after abdominal vagotomy, presumably due to enlarging of the esophageal hiatus or damage to the phreno-esophageal ligaments. Another presented a volvulus of the stomach in its transverse axis with the patient standing, while in the supine position the stomach was normal. The complaints in this instance were headache and variable digestive disturbances, including vomiting.

In another case a calcified lymph node situated between the pancreas and the posterior gastric wall simulated an ulcer crater. The calcified node was found at operation. Eight months later a small gastric ulcer was demonstrated a little lower down on the lesser curvature. Three characteristics are said to differentiate a calcified node from a barium-filled crater: the shadow is less dense and more regular in outline, and normal mucosal folds were present.

One patient presented an ulcer on the lesser gastric curvature surrounded by a rigid area. Histologic study after resection revealed a benign ulcer with pronounced lymphoid reaction and hemorrhage. In another case an ulcer on the greater curvature proved, on section, to be benign.

One case is presented as a pseudo-neoplasm of the stomach. The patient complained of epigastric pain not relieved by medical therapy. Barium meal study revealed an extensive rigid lesion along the lesser curvature. At operation a gastric mass, fixed posteriorly, was seen and seemed malignant. Histologic studies showed it to be inflammatory, a perigastritis.

An unusual picture was seen in one patient who had a raisin-skin phytobezoar following partial gastrectomy for peptic ulcer.

DIE ENTZUNDUNGSBESTRAHLUNG. By DR. MED. HABIL R. GLAUNER, Dozent für Röntgenologie und Strahlenheilkunde, Chefarzt der Röntgenabteilung am Marienhospital, Stuttgart. A volume of 190 pages, with 17 illustrations and 10 tables. Published by Georg Thieme, Stuttgart, 2d ed., 1951. Price $4.45. Distributed in U. S. A. by Grune & Stratton, 381 Fourth Ave., New York 16, N. Y.

Dr. Glauner published the first edition of his monograph on *Irradiation of Inflammations* in 1940 and completed a second edition only to have it destroyed in 1943 during a bombardment of the publishers' headquarters in Leipzig. In view of the changes brought about by the development of the sulfonamides and antibiotics, he decided to postpone the preparation of another edition until sufficient experience as to the therapeutic effect of these new drugs had been accumulated to determine their influence on the indications for roentgen therapy. While the first general part needed practically no changes, the second or special section had to be completely revised.

A historical chapter brings out the fact that roentgen rays were used in the treatment of inflammations as early as 1898 and refers to L. Freund's report in 1903 of his experience in the treatment of blepharitis, acne vulgaris, and a case of furunculosis.

The term "inflammation" is defined in a brief section, followed by a discussion of the effect of roentgen rays on local inflammatory processes, their effect on the causative agents and the general antibody reactions, on the clinical course of an inflammation produced experimentally, and on the course of the inflammatory process. Indications and contraindications are likewise outlined. An analysis of the experimental and clinical facts seems to point out that the basic effect of irradiation on an inflammation must be seen in the change of the actual tissue reaction; in other words, the acidosis present in the early stage is changed towards the alkaline side. The effect is in all probability due to a destruction of highly radiosenstive cells, as, for instance, leukocytes and lymphocytes. This may produce increased fermentative reactions both at the site of the inflammation and at distant points. It is very likely that the effect of irradiation on blood vessels plays a

role in the beneficial action; it relieves spasm and local hyperemia.

The quality of the radiation has apparently little influence on the end-results to be expected. It is most important to use the smallest dose necessary to achieve the therapeutic aim. The sooner the inflammatory process is irradiated after its development the more striking is the response. Chronic processes require higher doses. It is possible to see a definite effect with as little as 10 r, although the author states that the average doses vary between 50 and 150 r per treatment per field. The port of entry should be large enough to exceed the actually inflamed area. In some instances small doses may be given daily; chronic cases requiring doses as high as 200 r should not be treated oftener than every three days. It is inadvisable to irradiate an acute inflammatory process more than three or four times.

The clinical section deals with inflammatory diseases in the skin, the lymphatic tissue, the oral cavity, nose, sinuses, ear and eye, bones and joints, blood vessels, genito-urinary system, the female genital tract, the central and peripheral nervous system, and the peritoneal cavity, and in miscellaneous conditions including gas gangrene, human bites, and spurs of the calcaneus with inflammatory changes. A brief section on tuberculosis concludes this part of the book.

While satisfactory results may be expected in the majority of inflammatory processes, if seen early, roentgen rays have no place in the treatment of erysipelas. The same holds true for lobar pneumonia, except for a few chronic cases which do not resolve easily. Arthritis, orchitis, etc., on the basis of gonorrhea, which used to be subject to roentgen therapy, are no longer so treated. In tuberculosis, where roentgen therapy was widely used on the continent, the treatment has been discontinued except in cervical lymphadenitis.

It is the reviewer's opinion that every radiologist interested in this subject would benefit by reading this most complete treatise on roentgen therapy of inflammatory diseases. A bibliography consisting chiefly of German references is appended.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, G. A. Fricker, Sacramento Co. Hospital, Sacramento 17. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Charles E. Duisenberg, M.D., 300 Homer Ave., Palo Alto. Meets monthly, second Tuesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45 January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nelson T. Pearson, M.D., 1109 Huntington Bldg., Miami. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Theodore M. Berman, M.D., 350 Lincoln Road, Miami Beach. Meets monthly, last Wednesday 8:00 PM., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and with State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. John's Hospital, Springfield. Meets quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*. Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Donald S. Bottom, M.D., 510 S. Kingshighway Blvd. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meets quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meets in January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Irving Schwartz, 45 E. 66th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets quarterly.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 322 Demers Ave., Grand Forks.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lawrence Gibboney, M.D., Carew Tower Bldg. Meets first Monday, September to May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Todd Jessell, M.D., 224 Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, at 8:00 P.M., University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr. Next annual meeting, Aug. 9–11, 1951, Denver.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St., Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg., Houston 5.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 18–19, 1952, Houston.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meets fourth Monday, October through May, at College Club, Seattle.

Wisconsin

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Signs and Symptoms of Supratentorial Brain Tumors in Childhood. Edwin Boldrey, Howard C. Naffziger, and Lawrence H. Arnstein. J. Pediat. **37:** 463–468, October 1950.

Of 220 brain tumors found in children treated at the University of California Hospital on the Pediatric and Neurosurgical Services since 1941, 96 (44 per cent) have been located above the tentorium. Generally speaking, these tumors are slow-growing and have a better prognosis as to life than those below the tentorium. Their early diagnosis remains a major problem.

In the present series, the most frequently encountered tumor was angioma, which was present in 12 patients. Its predominance may be attributed to the recent interest in vascular diseases attending the development of cerebral angiography. Next in frequency was the Rathke pouch "cyst" (10 cases), with pinealoma and astrocytoma (7 of each) sharing third position. Meningiomas, dermoid cysts, and glioblastoma constitute the next group, followed by unclassified gliomas and polar spongioblastomas. The remainder of the series is composed of papilloma of the choroid plexus, neuroblastoma, hemangioendothelioma, metastatic carcinoma, ependymoma, neurofibroma, and oligodendroglioma.

Headache (58 per cent), vomiting (46 per cent), loss of vision (31 per cent), convulsive seizures (30 per cent), and ataxia (24 per cent) were the most common presenting symptoms. Clinical signs included papilledema (55 per cent); weakness of the extremities, usually unilateral (35 per cent); increase in size or distortion of the head (in children under five years of age) (25 per cent); nystagmus (15 per cent); cranial bruit (8 per cent).

X-ray examination of the skull is the most common laboratory procedure employed. In the infant, the roentgenogram may confirm the presence of separated sutures, enlargement of the head, and focal erosive changes, particularly about the base of the skull and in the region of the sella turcica. Erosion, either by direct pressure or by generalized increase in intracranial pressure, can be seen about the sella turcica in the older age groups, and this information may be of diagnostic value. Calcification of an intracranial mass was demonstrated in 30 per cent of the patients with supratentorial tumors. In half of these cases, the lesion was angioma, pinealoma, or Rathke pouch cyst. Epidermoid cysts within the cranium were next in number of calcified lesions. The x-ray pattern of calcification is seldom such as to permit prediction of the pathological nature of the neoplasm. More often localization of the calcification, as in the case of pinealoma and Rathke pouch cyst, has seemed a more justifiable basis for opinion concerning the character of the growth.

In the authors' experience, encephalography proved disappointing both for purposes of differentiation and localization.

Cerebrospinal fluid studies are rarely justifiable in tumors in childhood because of the dangers incident to the taking of cerebrospinal fluid from the lumbar sac when there is obviously increasing intracranial pressure.

Pneumoencephalography, either by the lumbar or the ventricular route, was employed in 33 patients with supratentorial tumors; in 31 instances it gave the correct localization. It is not generally used where plain films of the skull show calcification in a position to coincide with the clinical evidence of disease.

The recent advent of angiography has permitted the further elimination of error in the diagnosis in two groups of patients, those with angioma and those with other vascular lesions.

Venous Shunts in Bilateral Parasagittal Meningioma. Jefferson Browder and Harry Kaplan. Ann. Surg. **132:** 416–426, September 1950.

Bilateral parasagittal meningioma may obliterate the superior sagittal sinus by compression and/or invasion. Surgical resection of this sinus may be done without producing irreversible alterations in brain function, provided the lumen has already been occluded by the tumor, if the lesion is anterior to the rolandic veno-sinus junction. Eight cases seen by the authors fell into this group. Two others involved the rolandic veno-sinus junction, and in these cases quadriplegia followed by death resulted postoperatively. An eleventh case, subjected to multiple-stage removal, yielded a good result even though the lesion occluded the posterior half of the sinus.

The authors believe that collateral blood flow develops through enlarged emissary veins to the diploë and scalp rather than by retrograde flow through the superior cerebral veins. They injected 44 fresh autopsy specimens with contrast material after ligating the sinus just rostral to the torcular and were unable to fill the superior cerebral veins with pressures under 100 mm. Hg. They were able to demonstrate communication between the groups of superior cerebral veins, but these communications are not considered sufficient to counteract sudden occlusion of the superior sagittal sinus, especially in its posterior half.

Multiple-stage resection of the tumor and sinus is recommended if the occlusion involves the rolandic junction or is situated posterior to its entrance into the sinus.

Eight illustrations.

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Mt. Sinai Hospital, Cleveland

Hydranencephaly: Clinical Diagnosis. Presentation of Seven Cases. Wallace B. Hamby, Ruth F. Krauss, and William F. Beswick. Pediatrics **6:** 371–383, September 1950.

The term hydranencephaly refers to an anomaly which consists primarily of absence of the cerebral hemispheres within intact meninges and skull, the resulting cavity being filled with cerebrospinal fluid. The fluid circulation may be normal or the outlets of the ventricles may be closed; "hydrocephalus" results in either case. At operation or autopsy the most striking feature noted is absence of the cerebrum, although a few islands of it may persist. The pia arachnoid usually is intact. As the fluid is aspirated, two egg-shaped, white, glistening bodies representing the basal ganglia are seen on the floor of the skull.

The behavior of children with hydranencephaly appears to be normal at birth and for several weeks

thereafter. Enlargement of the head and irritability are early signs. Inco-ordinated movements of the eyes, strabismus, and nystagmus are frequent. The optic disks are small and pale. Manifestations of convulsive activity may be present. There is a tympanitic note on percussion of the skull. The electroencephalogram usually shows complete absence of electric activity. Upon transillumination of the skull light shows directly through the head, revealing no areas of opacity.

Ventriculograms may be helpful in diagnosis. The cranium is seen to be filled with air to the very periphery of the cavity (*i.e.* to the dura) without showing the contour of the ventricles. In the base of the skull are seen the shadows of the remaining supratentorial tissue masses. In the anteroposterior view in some of the cases evidence of midline tissue may be seen along the falx cerebri.

Seven cases of hydranencephaly identified by the authors in the past two years are presented.

Six figures, including two roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Encephalotrigeminal Angiomatosis (Sturge-Weber Syndrome), with Particular Reference to the Roentgenological Aspects Before and After Neurosurgery. John R. Green, John Foster, and David L. Berens. Am. J. Roentgenol. **64:** 391–398, September 1950.

A brief review of the history of and the typical findings in Sturge-Weber syndrome introduces a detailed case report of this relatively rare condition. The patient, an eight-year-old child, was admitted with a history of seizures, a "port-wine mark" covering the right side of the face in the distribution of the trigeminal nerve, left homonymous hemianopsia, and the pathognomonic roentgen findings in the skull. These last are sinuous, double-contoured lines of calcification which follow the convolutions of the cortex, tending to outline the sulci and gyri of the affected lobe, in this case the occipital.

Craniotomy was performed and the greater portion of the occipital lobe was removed. Pathologic study revealed calcifications in the cerebral cortex underlying the angiomatous leptomeninges, but no calcifications were demonstrated in the leptomeninges *per se*.

Films obtained a year and a half postoperatively showed that most of the involved brain tissue had been removed, although residual calcifications were still seen. The physical findings were unchanged. The patient, however, was completely free of symptoms, leading an entirely normal life.

Nine illustrations, including 4 roentgenograms.

RICHARD A. SILVER, M.D.
Indiana University

Intracranial Angiography in the Treatment of Cerebral Vascular Accidents. Reports of Cases and Review of Literature. Frank W. Lusignan and Glen O. Cross. California Med. **73:** 240–247, September 1950.

Five cases of intracerebral hematoma are presented, in 4 of which cerebral arteriography was performed. All 5 patients were operated upon; the clotted blood was evacuated and recovery followed. The arteriograms showed displacement of vessels and aided materially in establishing indication for surgery. No ill effects resulted from the angiography, even though spinal fluid pressure was elevated in each instance.

Although this was an unusual group as regards age, only one patient being over 50 and the others ranging from 23 to 33 years, the good results obtained lend encouragement for future work in cerebral vascular accidents. Stellate ganglion block and the use of aminophylline are also of considerable benefit in relieving spasm in the other cerebral vessels, a factor which plays an important part in the clinical picture.

Individual cases of a number of other cerebral vascular lesions diagnosed angiographically are also presented and illustrated.

Ten roentgenograms; 8 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Air Embolism During Pneumoencephalography. F. C. Coleman, J. R. Schenken, and W. D. Abbott. Am. J. Clin. Path. **20:** 966–969, October 1950.

Two cases of fatal air embolism occurring during lumbar pneumoencephalography are reported, bringing to 31 the number of recorded fatalities during or following this procedure. These cases are tabulated. In the majority, the cause of death was not determined. About 50 per cent of the patients had an intracranial neoplasm, and practically all of the remaining 50 per cent had brain or vascular changes.

The authors believe that the air probably enters the circulation through an epidural vein which is canalized by the lumbar puncture needle.

Introduction of gas under lower pressure and frequent checking to see that the needle is still in the subarachnoid space should make this complication less likely.

Radiologic Examination in a Case of Destructive Posterior Condylar Syndrome. P. Wettstein. Radiol. clin. **19:** 321–325, September 1950. (In French)

A 70-year-old woman presented signs of involvement of the left 9th, 10th, 11th, and 12th cranial nerves. Otoscopic examination was negative and routine skull films were essentially non-revealing, the basal view of Hirtz showing only a slight diminution of pneumatization of the left mastoid. A procedure described by Chaussé in 1938, however, showed osseous destruction in the region of the jugular foramen. For this examination, the patient is supine, the mouth open and the head inclined toward the side being examined. The central ray is directed toward a line connecting the uvula and upper third molar.

Cases similar to the author's have been described under the designation "syndrome of Vernet," due to primary tumors, metastases, trauma, arachnoiditis, and osteitis. Chaussé reported 8 cases due to angiomatous growths. Because of the slow evolution, over a period of ten years, the lesion in the author's case was presumed to be an angioma and irradiation therapy was given, with both symptomatic and objective improvement.

Four roentgenograms; 2 photographs.

CHARLES NICE, M.D.
University of Minnesota

Roentgenologic Aspects of Head Trauma. Robert J. Gross. Am. J. Roentgenol. **64:** 399–408, September 1950.

There are only two situations which ordinarily require emergency roentgen studies of the skull following

trauma: (*a*) If the patient's course suggests the presence of a tear of dural or meningeal vessels, roentgenography is indicated to ascertain the fracture site and the most probable site of rupture, to facilitate the operative procedure. (*b*) If physical examination and symptomatology suggest the presence of a depressed fracture, early roentgenography is again indicated so that corrective surgical measures may be instituted.

This paper is concerned chiefly with the later manifestations of head trauma. The roentgenographic findings in fracture, subdural hematoma, porencephaly, pneumocephalus, arachnoiditis, brain atrophy, leptomeningeal cyst, and epilepsy are considered. Discussion of each entity is concise. Characteristic cases are presented, and illustrations are excellent.

Nine roentgenograms. M. M. MANALAN, M.D.
Indiana University

Angio-Fibrosarcoma of the Ethmoid and Frontal Sinuses Complicated by Osteomyelitis of the Frontal Bone and Epidural Abscess. Morley T. Smith, Peter D. Latella, and I. M. Schnee. Ann. Otol., Rhin. & Laryng. **59:** 650–656, September 1950.

A colored male, aged 27, was admitted to the hospital May 8, 1946, with a history of severe frontal headache, nausea, and vomiting, developing suddenly eight weeks previously, with chills and fever a month later. A slight firm swelling was present over the right frontal region, tender on palpation. It was not sharply demarcated and showed no fluctuation. Occupying the greater part of the right nasal cavity was a large polypoid mass, rather firm and smooth, without ulceration, and apparently originating in the middle meatus. A posterior rhinoscopy showed it to extend slightly beyond the choana into the nasopharynx.

X-ray examination of the accessory sinuses and skull showed antral clouding, fairly marked on the right and less marked on the left. A diffuse haze in the region of the right ethmoid cell group and in both frontal sinuses was present. Superior to the upper margin of the right frontal sinus, a small area of decreased tissue density was noted and was interpreted as a rarefying osteitis. A chest film was negative.

A diagnosis of suppurative sinusitis with nasal polyps, complicated by osteomyelitis of the frontal bone and possibly brain abscess, was made. On June 6, 1946, an external radical frontal and ethmoid operation was performed. On opening the right frontal and ethmoid sinuses a soft vascular tumor was seen to fill each sinus completely, forming one continuous mass, which eroded the bone in its path. The diploic region and the deep surface were grossly necrotic and purulent. The mass that filled the frontal sinus was found to be adherent to the dura, and a considerable quantity of pus escaped from a pocket between the frontal bone and dura (epidural abscess).

Three days later, a frontal osteotomy was performed; a large portion of the right frontal bone, with small portions of the right parietal and left frontal bones, was removed. In the second week the wound was completely healed. X-ray therapy to the frontal and ethmoid sinuses was started on July 10 and continued until Sept. 4, 1946, a total of 3,600 r (in air) being given to each side. Four years postoperatively, no evidence of recurrence was noted.

The operative specimen consisted of numerous masses of rather firm, grayish-white homogeneous tissue, shown microscopically to be made up of numerous spindle and stellate cells with vesicular nuclei and a large amount of intercellular fibrillae. The diagnosis was angiofibrosarcoma.

This type of tumor in the sinuses has only rarely been reported.

Four roentgenograms. STEPHEN N. TAGER, M.D.
Evansville, Ind.

Basilar Skull Fractures. David P. Cordray. Ann. Otol., Rhin. & Laryng. **59:** 591–601, September 1950.

Basilar skull fractures occur in the areas of greatest structural weakness. The obviously weak area of the anterior fossa is the thin cribriform plate. The great weakness of the middle fossa lies in the number of large foramina directly anterior to the petrous pyramid, namely, the foramina spinosum, rotundum, and ovale. Fractures involving the middle fossa usually occur directly anterior to the petrous bone. The posterior cranial fossa has two sturdy supports; the firm bony rim of the foramen magnum, and the occipital protuberance. The floor lying between these is the point of weakness and is the basal point of fracture.

The two factors which cause fractures of the base are an external force applied directly and transmitted force from a blow delivered elsewhere, such as the vault. The fractures are classified according to their locations in the three fossae.

The two cardinal signs of fracture in the anterior fossa are hemorrhage and edema. Since the cribriform plate is rarely spared, subconjunctival, palpebral and peripalpebral hemorrhage is normally observed. There is almost always associated bleeding from the nose and mouth, due to tearing of the ethmoid vessels or rupture of the cribriform plate. Three nerve groups in the anterior fossa may be affected by fracture. They are the optic, olfactory, and those passing through the superior orbital fissure—namely, the third, fourth, sixth, and the ophthalmic division of the fifth.

The outstanding finding in fracture of the middle fossa is hemorrhage from one or both ears, sometimes associated with escape of cerebrospinal fluid. Fractures involving the middle fossa invariably extend into the temporal bone, which is involved in over one-third of all cases of basal skull fracture. The fractures may be longitudinal or transverse, or there may be rupture of the tip of the petrous portion. The second division of the fifth nerve passes through the foramen ovale, and is only occasionally injured in fractures of the middle fossa. The sixth nerve is more often involved, due to its course and the ease with which extravasated blood may cause pressure in the region of the petroclinoidal ligament. The seventh and eighth nerves are also particularly vulnerable because of their intrapetrous position.

In fracture of the posterior fossa, hemorrhage is again a cardinal sign, though becoming evident much later. These fractures do not show the dramatic symptomatology of fractures involving the other fossae, and frequently a strictly clinical diagnosis is impossible. The ninth, tenth, and eleventh nerves are rarely involved unless the injury is most severe.

No fracture of the base which does not include the calvarium is roentgenographically demonstrable. Accurate interpretation of head films is especially demanding, since it is difficult to distinguish between a fracture line and a normal anatomical shadow. The grooves for the middle meningeal artery create confus-

ing shadows. Whether or not a fracture crosses a vessel groove should always be indicated in the x-ray report.

Fractures involving the temporal bone do not heal by bony union and always present a potential danger of meningitis.

A brief summary of treatment emphasizes the importance of keeping spinal fluid pressure at a normal level, the use of antibiotics in compound fractures, bed-rest, and avoidance of packing the ear canal or the nose in cases of escaping cerebrospinal fluid.

One illustration. STEPHEN N. TAGER, M.D.
Evansville, Ind.

THE CHEST

Nature of the Lesions Encountered in Routine Chest X-Rays. Robert V. Slattery, William G. Beadenkopf, and Clayton G. Loosli. J. Lab. & Clin. Med. **36:** 617–631, October 1950.

In the period between Jan. 1, 1947, and June 1, 1948, a chest survey with 70-mm. film was made of 10,598 students at the University of Chicago. Each student was tested with tuberculin, histoplasmin, and coccidioidin. The microfilm findings were abnormal in 351 students (3.3 per cent), and 320 of these returned for further investigation. Stereoscopic 14 × 17-inch films were normal in 155. Ninety-five students had non-calcified pulmonary infiltrates; 25, skeletal abnormalities; 23, cardiac abnormalities; 22, miscellaneous diseases of the chest.

Fourteen per cent of the pulmonary infiltrates were found to be active tuberculous lesions; 30 per cent, though the etiology was not demonstrated, were considered non-tuberculous on the basis of insensitivity of the patient to tuberculin; the remaining 56 per cent (etiology not determined) could potentially be found in later examinations to be tuberculous on the basis of sensitivity to tuberculin.

In 3 students, active pulmonary tuberculosis developed within periods of four, twelve, and fourteen months after the original roentgen examination had shown no lesion. The environments of these students were not found to be unusual, and no source of tuberculous infection was found among their contacts.

Six roentgenograms; 11 tables.

Early Detection of Bronchogenic Carcinoma. Robert R. Shaw. Dis. of Chest **18:** 185–197, September 1950.

An analysis of 210 cases of bronchogenic carcinoma covering a three-year period showed 50 per cent to be inoperable when first seen because of metastases, invasion of the chest wall precluding successful resection, or the poor general condition of the patient; in 25 per cent cure or palliation was thought possible, but at the time of surgery resection could not be accomplished; the remaining 25 per cent were suitable for surgical resection, but in a number of these only palliation was attempted, since there was no chance for complete cure. Further study revealed that there was a delay of five months between the onset of symptoms and the first visit to a physician, with an average loss of another six months between the first visit to the physician and the making of a correct diagnosis.

Among 72 resections, there were 5 deaths, a mortality of 6 per cent. Because of the age of these patients and the technical difficulties encountered in resection, it is not believed possible to reduce the mortality rate appreciably. The only hope for improving the overall results of surgical treatment lies in early detection. And yet, in about 40 per cent of the cases diagnosis in an operable stage is not possible. A certain number will have undifferentiated carcinomas, which are highly invasive and metastasize early. Another group of patients have no preliminary symptoms and the initial complaint is due to a metastatic lesion, such as headache, loss of voice, painless pleural effusion, difficulty in swallowing, and skin lesions, all indications of inoperability.

The time interval between the first symptom and the first visit to the physician can be reduced only by educating the patient. The time interval between the first visit to the physician and the making of a correct diagnosis is the doctor's responsibility. The delay is usually due to an error in the original diagnosis, the condition being most frequently mistaken for asthma, bronchitis, unresolved pneumonia, virus pneumonia, tuberculosis, or fungous diseases, with virus and unresolved pneumonia heading the list.

The diagnosis is made by a careful correlation of the history, laboratory findings, x-ray examination, bronchoscopy if indicated, and exploratory thoracotomy. The early symptoms are wheeze, cough, and expectoration of blood-streaked sputum. Pain, dyspnea, fatigue, and weight loss are all evidence of advanced disease.

X-ray inspection of the chest using both postero-anterior and lateral films is the most valuable diagnostic method. The neoplasm itself may not be visualized but its effect in blocking the bronchus may give rise to shadows which are obvious. The pattern of these shadows in being limited to a lobe or to a segment of a lobe is highly suggestive of a block in a bronchus with suppuration beyond. Since neoplasms tend to be in the major bronchi situated in the root of the lung, it may be hard to interpret small changes in this region because of the presence of large vessels and lymph nodes. The lateral film will enable one to visualize many of these obscure areas. Especially significant is the small, sharply circumscribed mass which may lie directly in the hilar area within the arch of the aorta, as shown on the lateral film. This is highly suggestive of a neoplasm and with the clinical history may be sufficient to make an absolute diagnosis. In many patients an x-ray film of the chest after instilling iodized oil into the tracheobronchial tree will yield valuable information. An abrupt block of a bronchus or the tapering of a branch bronchus as shown by the oil filling may lend further support to a diagnosis of bronchial neoplasm. Asymptomatic bronchogenic carcinomas have been found in mass x-ray surveys.

Bronchoscopy is a valuable procedure for diagnosis and also for determining operability, but peripheral lesions, as well as lesions in second order bronchi of the lower lobes and first order bronchi of the upper lobes are not accessible for biopsy by this route. Secretions aspirated during bronchoscopy may be examined for tumor cells. Negative findings, however, do not exclude the possibility of a bronchogenic carcinoma.

Exploratory thoracotomy is a relative safe procedure and is recommended even in the absence of a positive pathological diagnosis.

"The passage of time", the author states, "is not on the side of the patient." Therefore, it is unwise to advise a patient to wait for a specified period in order to see what will happen either to symptoms or to an unexplained shadow on a roentgenogram. Vigilance

on the part of the general practitioner and insistence upon accurate diagnosis of pulmonary lesions will bring many more patients having bronchogenic carcinomas to the thoracic surgeon at a stage where the lesion can be completely resected. HENRY K. TAYLOR, M.D.
New York, N. Y.

Multiple Cancers: Primary in the Lung and Other Sites. William G. Cahan, Frank S. Butler, William L. Watson, and John L. Pool. J. Thoracic Surg. **20:** 335–348, September 1950.

When a patient who has a cancer which is known to metastasize shows pulmonary symptoms or a roentgenographic shadow suggestive of lung cancer, the problem of establishing the true nature of the process is vital and often requires extensive clinical and laboratory study.

Of 1,493 patients with primary lung cancer seen at Memorial Hospital, New York, 25 had multiple primary malignant neoplasms. In 15 cases the second tumor was discovered within six months of the first; in 10 cases the interval was twelve months or longer. In no instance did the lung tumor antedate the discovery of a second growth by any significant length of time.

The alertness of the radiologist to the possibility of a new primary tumor may be of the utmost importance. The correct diagnosis was suggested roentgenographically in 10 cases in the series reported here. Primary lung cancer was suspected for the following reasons: the infrequency with which certain cancers metastasize to the lung and the shape of the shadow, usually associated with a segmental atelectasis. The appearance of radiographic evidence of a growth in the lung on a check-up film should not be interpreted as evidence of treatment failure until every effort has been made to determine the nature of the pulmonary growth. The discovery of a second or third (the authors report a case with primary lesions of the breast, rectum, and lung) primary cancer does not contraindicate definitive or radical therapy. Surprisingly favorable results have been obtained in the treatment of these cases.

Criteria for multiplicity are defined. The two tumors may have different histologic characteristics, as squamous carcinoma of the palate and adenocarcinoma of the lung. If they have the same histopathology, reliance is placed upon the clinicopathologic picture, as in squamous carcinoma of one vocal cord and an epidermoid carcinoma of the right upper lobe bronchus; metastasis of either lesion to the other site is very unlikely.

Four roentgenograms; 5 photomicrographs; 1 photograph; 3 tables. DONALD DEF. BAUER, M.D.
St. Paul, Minn.

A Study of 200 Cases of Tuberculous Pleurisy with Effusion. John C. Sibley. Am. Rev. Tuberc. **62:** 314–323, September 1950.

The author's material comprises: (1) patients with spontaneous pleural effusion with or without tuberculosis, in whom no cause for the effusion other than tuberculosis could be demonstrated; (2) patients with tuberculosis in whom pleural effusion developed during their hospital stay; (3) patients who previously had an "idiopathic" pleural effusion. All patients included were in the Mountain Sanatorium, Hamilton, Ontario, at some time between Jan. 1, 1939, and July 1, 1947. There were 107 males and 93 females in the group with an average age of 25.3 years; racial distribution was not significant, and the side involved most frequently was the right, with bilateral effusion in 19 cases.

The onset was acute in 147 patients, insidious in 28, and chronic in 6 patients. The most common symptoms were pain, fever, general malaise with fatigue, chills, sweats, and some dyspnea. In 10 per cent there was intermittent chest pain, preceding the effusion by three to six months. The size of the effusion was of no prognostic significance. Three cases showed persistently bloody fluid; all others were clear. Cultures were obtained in 74 cases, and 21 of these were positive for tubercle bacilli. Tuberculosis was present or developed in 102 patients, with pulmonary lesions in 92 of them. Definite hematogenous extrapulmonary lesions of tuberculosis developed in 37 patients, and their presence was noted on an average of 21.2 months following the effusion.

Radiological clearing of the effusion was complete in 35 patients, with blunting of the costophrenic sulci in 82 and moderate to extensive pleural fibrosis in the others. There were 14 deaths in the group, 13 of which were due to tuberculosis or complications as the result of tuberculosis. The value of aspiration in the treatment was studied but no definite conclusions could be drawn.

The author concludes that pleural effusion should be considered as evidence of possible hematogenous spread of tuberculosis even if it occurs with no visible parenchymal lesion. These patients, therefore, should be studied extensively in an effort to find evidence of the disease, and treatment should include the usual general and specific measures used in tuberculosis, including sanatorium care. Several case histories are presented to illustrate the points under discussion.

One drawing; 5 tables. JOHN H. JUHL, M. D.
University of Wisconsin

Radiological and Pathological Correlation of Miliary Tuberculosis of Lungs in Children, with Special Reference to Choroidal Tubercles. J. L. Emery and J. Lorber. Brit. M. J. **2:** 702–705, Sept. 23, 1950.

The chest roentgenograms of 52 children under fourteen years of age with miliary tuberculosis, proved at necropsy, were submitted to a four-man panel (two radiologists and two pediatricians) for diagnosis. None knew the others' opinions at the time of viewing but all were told that the patients had died of tuberculosis.

In only 12 cases out of the 52 was a definite diagnosis of miliary tuberculosis made on the last film before death; in 6 others the findings were definite on older films but so modified by streptomycin at the time of the last examination that the diagnosis could not be made. In those cases which could be diagnosed it was found, as might be expected, that the tubercles were larger and more numerous than in the others.

The ocular fundi were searched for tubercles in almost all cases and a high correlation with the positive x-ray findings was demonstrated (15 out of 17 had choroidal tubercles). In the group with negative x-ray findings, choroidal tubercles were found in only 10 out of 31 examined. It was observed that if a patient with tuberculous meningitis had choroidal tubercles, he also had miliary tuberculosis whether or not this was apparent on the chest film.

Since specific treatment is now available for miliary tuberculosis, it is important that we strive for early

diagnosis, before irreparable harm is done to the central nervous system. It is clear from this study that our present methods of diagnosis are quite inadequate.

Three tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Tuberculosis Case Finding in General Hospitals. Zella Bryant. Pub. Health Rep. **65:** 710–722, June 2, 1950.

This is a summary of several previously published reports dealing with the incidence of unsuspected tuberculosis among patients admitted to general hospitals. These studies appear to show that approximately 1 per cent (0.6 to 1.8 per cent) of such patients have active pulmonary tuberculosis. Nevertheless, a recent survey by Oatway (Arizona Med. **6:** 23, 1949) revealed that only 247 of the 4,539 general hospitals in the country had some routine survey program in effect. Since the incidence of tuberculosis among patients admitted to general hospitals is higher than that of the general population, routine chest films of all patients so admitted should be an effective case-finding tool. Protection of hospital personnel from exposure to these unsuspected cases is an important consideration.

Hospitals in New York and Wisconsin now may receive state aid to carry out a program of routine chest filming of all patients admitted. Successful operation of such a program requires co-operation by the entire hospital staff. It cannot be carried out by the X-ray Department alone.

Five tables.

GEORGE R. KRAUSE, M.D.
Mt. Sinai Hospital of Cleveland

Geographic Distribution of Pulmonary Calcification Among University Students in Ohio. John A. Prior, John W. Wilce, and William Palchanis. Pub. Health Rep. **65:** 1132–1138, Sept. 1, 1950.

Studies of 4,829 students in Ohio State University by means of chest films and tuberculin and histoplasmin tests, conducted in the fall of 1946 and 1948, demonstrated that the distribution of pulmonary calcification in Ohio followed a definite geographic pattern. This pattern of prevalence very closely parallels the geographic distribution of histoplasmin reactors, but does not correspond to the distribution of tuberculin reactors. The prevalence of tuberculin reactors tends to be higher in the metropolitan areas and lower in rural sections. In contrast, the prevalence of both pulmonary calcification and histoplasmin reactors tends to be higher in the rural sections than in urban areas, and also shows a definite geographic pattern. Although many calcifications are undoubtedly due to tuberculosis, these facts tend to support the growing belief that most pulmonary calcifications in Ohio and other Middle Western states probably are the result of a benign, widespread form of histoplasmosis or antigenically related agents.

Two illustrations; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

Angiocardiography in Artificial Pneumothorax. Israel Steinberg, Herbert I. McCoy, and Charles T. Dotter. Am. Rev. Tuberc. **62:** 353–359, October 1950.

This report illustrates the changes occurring in the pulmonary circulation in artificial pneumothorax in the living patient as shown by angiocardiography. For the most part, angiocardiography was conducted as originally described (J. Clin. Invest. **17:** 507, 1938. Am. J. Roentgenol. **41:** 1, 1939), with a standard stereocassette changer permitting two exposures per injection. Either neo-iopax (75 per cent) or diodrast (70 per cent) was used as the contrast medium.

Twenty-three patients with tuberculosis were studied before, during, and after artificial pneumothorax. Of these, 2 had had bilateral pneumothorax. Interpretation of pulmonary vascular changes were made from comparison of the opacified pulmonary circulation of the collapsed lung with that of the noncollapsed lung, and from a comparison of serial contrast studies in the same individual. These changes included variations in the caliber, degree and rate of filling, position, and configuration of the pulmonary vessels.

The authors found that angiocardiography usually demonstrates avascularity at the site of moderately advanced or far advanced lesions of pulmonary tuberculosis. Following artificial pneumothorax the following changes may be noted (*a*) decrease in the vascularity of the collapsed lung in proportion to the degree of collapse; (*b*) delay in rate of the blood flow in the collapsed lung; (*c*) crowding, distortion, and displacement of the pulmonary blood vessels in the collapsed lung; (*d*) varying degrees of shift of the heart, great vessels, and mediastinum to the side opposite the pneumothorax.

In "fibrothorax" following re-expansion of a pneumothorax, angiocardiography serves to delineate the cardiovascular structures, showing retraction and torsion of these structures and a decreased vascular supply to the affected side.

These angiocardiographic findings supplement and confirm previous necropsy studies. Changes shown by this procedure are apparently not due to agonal processes, as has been suggested, but represent the vascular status during life.

Nine roentgenograms.

Lung Abscess. W. L. Phillips. South African M. J. **24:** 787–797, Sept. 16, 1950.

Pulmonary abscess formation may be initiated *via* the bronchi, the blood stream, direct implantation, or by degeneration or necrosis within the lung. Gravity influences the localization of the abscess. The dorsal and basal regions of the lower lobe are most commonly involved, though abscess of an upper lobe is not infrequent.

The typical lung abscess shadow is rounded and contains a cavity with a fluid level. The surrounding lung is of normal appearance, though the hilar lymph nodes draining the area may be enlarged. A less characteristic picture shows no evidence of fluid level; the shadow in these cases is usually well defined, and may be rounded or conical, resembling the shadow due to carcinoma. To complicate matters, the abscess may be the result of bronchial obstruction due to a small carcinoma.

Additional radiographic information may be obtained from a penetrating view or from tomography. Bronchography may reveal a lung abscess which might otherwise not be demonstrated. The medium will enter the abscess cavity, where it is apparent as globules of iodized oil. Bronchography is also essential to exclude residual lung damage following treatment.

All patients should have the benefit of bronchoscopy to determine whether a foreign body or carcinoma is the cause of the abscess. Occasionally a draining bronchus may be emptied by the bronchoscope.

As with other inflammations, the abscess may go on to complete resolution, aided by the emptying of its contents into the bronchial tree. Contrarily, it may extend through the lung tissue, advancing to massive necrosis of the lung. Incomplete healing or conversion into a chronic lung abscess may occur. An interesting sequel is epithelization of the residual cavity, which becomes lined by ciliated, columnar epithelium, the final appearance being that of a cyst.

Fifteen roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Boeck's Sarcoid. A Review Based upon a Clinical Study of Fifty-Two Cases. Edgar Alsop Riley. Am. Rev. Tuberc. **62:** 231–285, September 1950.

The author presents a study of 52 cases of generalized sarcoidosis. The diagnosis was based on biopsy and autopsy findings in 85 per cent and on clinical and laboratory findings in the remaining 15 per cent.

A large amount of material has appeared in the literature regarding sarcoidosis, and a number of terms have been used to describe various manifestations of the disease. "Boeck's sarcoid" or simply "sarcoid" are the most widely accepted terms in this country, while the term "benign lymphogranulomatosis" is used abroad.

The histopathologic changes are well known, consisting of granulomatous epithelioid tubercles which may completely replace the normal architecture of the organ in which they appear. Giant cells were found in all of the cases in this series in which histologic studies were done. The presence of caseation is believed to make the diagnosis untenable, and is the one definite morphological feature differentiating tuberculosis from sarcoidosis. It is important to remember that the same microscopic pattern may be caused by a number of different etiologic agents. The term "sarcoidosis" should be reserved for the generalized disease with evidence of widespread foci.

Over 50 per cent of the patients in this series were Negro females; altogether, 79 per cent of the patients were Negroes. Over one-half were in the third decade of life, the general range being from ten to fifty years. Only 17 per cent of the patients were completely asymptomatic; the remainder had complaints directly referable to the disease, cough, sputum, weight loss, and shortness of breath being the most common. Physical signs depended on the sites and severity of involvement. Adenopathy was found in all cases, with peripheral nodes in 60 per cent and mediastinal nodes in 85 per cent. Splenomegaly was present in 40 per cent and hepatomegaly in 37 per cent, while ocular involvement occurred in 29 per cent and osseous lesions in 13 per cent. Pulmonary involvement was found in 87 per cent, making it the most common form of the disease. Elevated sedimentation rate (78 per cent), elevated serum globulin (68 per cent), elevated alkaline phosphatase (47 per cent), positive cephalin flocculation (45 per cent), and anemia (25 per cent) were the most frequent laboratory findings. Bacteriologic studies were unrevealing; 65 per cent of the patients were non-reactors to tuberculin.

Bone lesions, which were demonstrable roentgenographically chiefly in the phalanges, were of two types occurring with about equal frequency in this series. The first type consisted of well localized, sharply defined radiolucencies without evidence of surrounding inflammatory reaction. The second consisted of a coarse reticular or lacy appearance of the medullary portion of the involved bone with associated cortical thinning. When extensive, the bone lesions were accompanied by soft-tissue swelling and considerable deformity but little pain. Joint involvement was conspicuously absent.

Chest findings were limited to mediastinal adenopathy in 15 per cent, while 31 per cent showed pulmonary lesions of a linear strand-like character radiating from the hili and accompanied by massive hilar adenopathy. Diffuse changes, consisting in widely disseminated bilateral nodular foci, were present in 20 per cent, and in this group the mediastinal adenopathy was not marked. A combination of the two types of pulmonary involvement was noted in 22 per cent. In 18 per cent of the group with parenchymal involvement, the changes consisted of diffusely scattered more confluent patchy densities than in the nodular group. In 3 cases the parenchymal infiltration was characterized by a rather soft granularity, and in one case a pneumonic consolidation not unlike a pyogenic or tuberculous pneumonia was noted on one side.

Correlation of the pulmonary lesions as seen on the roentgenogram and the histopathologic changes is difficult, because the only material available for histologic study is an occasional advanced case with widespread fibrosis or with frank tuberculosis. The densities as seen in the pulmonary parenchyma may be due to the disposition of the sarcoid tissue along the perivascular and interstitial septal lymphatics. Another explanation is that the changes are secondary to obstruction and stasis in the lymphatics due to pressure from the nodal enlargement or to actual edema and stasis within the node itself.

The author feels that the type of pulmonary parenchymal involvement is of some prognostic significance, since almost 40 per cent of the patients who showed clearing were in the group showing a fan-like distribution of linear densities extending out from the hilus. Nodular foci, particularly those showing a tendency to coalesce, were more likely to progress to fibrosis or pulmonary tuberculosis. In most instances the clearing occurred over a period of several years, but in one patient regression was complete in "a few months."

Sarcoidosis is not the benign disease that some authors indicate, since ocular morbidity is high (only 1 complete recovery in the patients with ocular involvement in this series) and in 8 per cent of the patients cor pulmonale occurred secondary to the pulmonary fibrosis, to say nothing of the additional 13 per cent in whom clinically active tuberculosis developed. There were 10 deaths (19 per cent) related to sarcoidosis and in only 14 per cent was there complete resolution of the disease. The disease was stationary in 10 per cent, however, and was regressing in an additional 19 per cent.

Therapy of all types has been disappointing, with no apparent benefit from bed rest despite the relationship to tuberculosis and the generally accepted theory of the infectious nature of the disease. Perhaps some of the newer antibiotics will prove to be effective. The various theories of the etiology are discussed at length, particularly the relationship to tuberculosis and the

high incidence of negative tuberculin reactors. The author concludes that the etiology is unknown but that there must be some relationship between tuberculosis and sarcoidosis. A number of case reports are included to illustrate the various manifestations discussed. An extensive bibliography is appended.

Twenty-four roentgenograms; 10 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Pulmonary Paraffinoma (Lipoid Pneumonia): A Critical Study. Ralph Berg, Jr., and Thomas H. Burford. J. Thoracic Surg. **20:** 418–426, September 1950.

In 1937, Ikeda gave the name "paraffinoma" to a tumor-like, advanced lesion of the adult lung which may be defined as follows: a densely fibrous, granulomatous, productive inflammation occurring as one or more sharply demarcated nodular masses, with a lobar or lobular bronchus as the center. The masses contain oil-filled cavities. Mineral oil in some form is the sole etiologic agent.

The infantile type of lipoid pneumonia due to mineral oil represents temporarily the initial stage of the adult type and consists of a process in which alveoli are occupied by oil-filled macrophages and free oil globules. The lesion is usually more extensive than the adult type and unaccompanied by the late changes of fibrosis and granuloma formation. In both the adult and infantile form there is surprising lack of hilar lymphadenopathy. This serves to distinguish infantile lipid pneumonia from tuberculosis, and paraffinoma from advanced carcinoma.

Clinically paraffinoma may mimic carcinoma, with such symptoms as chronic cough, hemoptysis, and low-grade fever. The radiographic picture may also be confusing and even frozen section may suggest carcinoma because of the productive characteristics.

Radiographic features are the typical location in recognized "aspiration areas," as, for example, the apical divisions of lower lobes and subapical segments of upper lobes. The shadow is homogeneous, with sharply defined edges except toward the hilus, where the edge is feathery (due to macrophage transport of oil to the hilus via peribronchial lymphatics). Hilar adenopathy, as mentioned above, is not present. Shadows are permanent and may be multiple and bilateral.

Six cases are reported.

Five roentgenograms; 1 photomicrograph.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Stannic Oxide Pneumoconiosis. Carroll C. Dundon and James P. Hughes. Am. J. Roentgenol. **63:** 797–812, June 1950.

The authors report the clinical and autopsy findings in an unusual type of benign pneumoconiosis, due to stannic oxide, discovered in a patient with carcinoma of the prostate on chest roentgenography. The patient had been exposed to stannic oxide in the form of fumes and dust for eighteen years while tending a detinning furnace. He had no respiratory symptoms. It is believed that industrial and mass surveys may reveal other cases in persons without symptoms, since the roentgen appearance is striking.

In the case reported here discrete shadows were present throughout the pulmonary fields, having the density of lipiodol droplets, varying from less than 1.0 mm. to about 2.0 mm. in diameter. The shadows were evenly scattered throughout the lungs 2 mm. to 4 mm. apart. There was no evidence of enlarged hilar lymph nodes.

The gross and microscopic appearance of the lungs is carefully described. The most conspicuous feature was the presence of particulate dark brown and black pigment in the alveolar walls and interalveolar septa, at the angular junctions of alveoli, in the interlobular septa, in the peribronchial and perivascular regions, and in the subpleural lymphatics. Accumulations were heaviest in emphysematous foci. The pigment occurred both as discrete particles and as dense, rounded clumps. The particles measured by micrometer eye piece had a range of from 0.5 to 1.6 microns, with a mean of 1.0 micron. In the bronchi, there were large focal accumulations of black pigment in the region of and lateral to the mucous glands. The largest intrapulmonary pigment masses occurred at the sites of lymphoid nodules at the bifurcations of bronchi and bronchioles.

Micro-incineration studies showed definite differences between the unstained sections from this case and sections obtained from anthracotic and silicotic lungs. Indeed, there was a very close similarity between the micro-incinerated sections and those which had been previously stained in routine fashion. Several other tests were performed to prove the stannic constitution of the particles within the above described lung. Spectrographic analyses were also carried out. The amount of tin demonstrated in the lungs was enormous in comparison with normal concentrations. The specific compound demonstrated was stannic oxide (SnO_2).

The position of stannic oxide pneumoconiosis is discussed with relation to other types of pneumoconioses, as is the toxicity of tin (one of the least toxic of the common metals).

Ten illustrations, including 2 roentgenograms; 2 tables.

I. MESCHAN, M.D.
University of Arkansas

Bilateral Spontaneous Pneumothorax. Nils Frostberg. Acta radiol. **34:** 154–160, September 1950.

Formerly, spontaneous pneumothorax was generally regarded as definite evidence of a tuberculous lesion of the lung. The author states that pneumothorax is also known to develop in other diseases of the lung such as pulmonary gangrene, pulmonary abscesses, and pulmonary tumors. Frequently, however, it develops spontaneously in apparently healthy individuals, in whom none of the above factors appears to be responsible.

Bilateral spontaneous pneumothorax is rare. Up to 1937 only 19 cases were said to have been reported (see Hasney and Baum: Radiology **28:** 47, 1937). This number has since been increased and the author adds still another example.

An 8-year-old girl was found to have an irregular shadow in the right lung field during the course of a mass chest survey. Roentgenographic examination disclosed bilateral pneumothorax. No definite changes were noted in the parenchyma. At the time of writing the child had been under observation for one year, but no effect of the pneumothorax on her general condition was apparent.

Two roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Situs Inversus, Bronchiectasis and Sinusitis. Report of a Family with Two Cases of Kartagener's Triad and Two Additional Cases of Bronchiectasis Among Six Siblings. W. H. Bergstrom, C. D. Cook, J. Scannell, and William Berenberg. Pediatrics **6:** 573–580, October 1950.

Kartagener in 1933 (Beitr. z. Klin. d. Tuberk. **83:** 489, 1933) reported 4 cases of concurrent bronchiectasis, situs inversus, and sinusitis, a triad which now bears his name. Up to the present, 80 such cases have been recorded, but in only 16 has clear-cut roentgen evidence of bronchiectasis been presented.

The coincidence of bronchiectasis and situs inversus—borne out by surveys which demonstrate that bronchiectasis occurs in 12 to 23 per cent of cases of transposition of the viscera—supports the hypothesis advanced by Kartagener and others that hereditary predisposition may be a determining factor in certain cases of bronchiectasis. This would appear to be true in the family described in the present report. Of the 6 children, 2 presented the picture of Kartagener's syndrome and 2 had bronchiectasis and sinusitis without dextrocardia. Symptoms of clinical bronchiectasis of the so-called acquired type appeared in all 4 in early childhood, and in all profuse nasal discharge was a prominent feature. Two of the 4 had other anomalies in addition to complete transposition of the viscera. Lobectomy was required in 2 of the children.

The horizontal distribution of the abnormalities of Kartagener's triad suggests an environmental factor active at the start of embryonic life rather than a genetic factor which should, if present, become apparent in more than one generation, but the extent and number of family histories available do not justify any conclusion on this point. It does seem reasonable to conclude, however, that such cases of bronchiectasis are the result of antenatal influences. Whether this congenital abnormality be an actual structural defect, a physiologic failure of the respiratory epithelium, or a predisposition to infection, has not been determined.

Two roentgenograms; 1 diagram; 1 table (showing details of collected cases).

Mediastinal Emphysema. John A. Evans and Ted R. Smalldon. Am. J. Roentgenol. **64:** 375–390, September 1950.

This paper reviews the causes, mechanism of production, and effects, as well as clinical and roentgen findings, in mediastinal emphysema. Fifty cases from the New York Hospital are tabulated, demonstrating some of the circumstances under which the condition can occur.

Air may reach the mediastinum *via* four pathways: (1) by way of the interstitial tissues of the lungs, (2) along the fascial planes of the neck, (3) through perforations of the trachea, bronchus, or esophagus, and (4) by dissection along the retroperitoneal spaces. The first mechanism is the most common: as a result of hyperinflation or pulmonary disease, the alveolar base ruptures and the escaping air courses along the pulmonary vessels to the hilus and enters the mediastinum. This should be considered in evaluating cyanosis and dyspnea in cases of acute pulmonary infection, in asthma, in the newborn, and in postoperative cases where pleural trauma is unlikely. Pneumomediastinum by one of the three remaining mechanisms may result from trauma to the chest, tracheotomy, endoscopy, cervical, thoracic or abdominal surgery, and as a result of double contrast barium enema examination or perirenal insufflation. Spontaneous emphysema is more uncommon, of unknown etiology, and usually benign. It may be more frequent, however, than is usually thought, occurring subclinically and passing unrecognized.

The effects of air in the mediastinum are the result of increased mediastinal pressure, producing interference with flow of blood through the large veins into the heart. This results in dyspnea and cyanosis plus mild or severe pain, sometimes simulating coronary disease. "Hamman's sign," a characteristic crunching sound with each heart contraction, may be elicited and is the result of air over the cardiac tissues.

The authors stress the value of lateral projection in roentgenographic diagnosis of the condition. On the postero-anterior film, one or both pleural reflections may be seen as thin lines outlining the pericardium, and a globular radiolucency overlying the cardiac shadow may be visualized. However, the presence of air may be hidden by bony structures of the thorax lying in the same projection field. Hence lateral and oblique views are a great aid in establishing a diagnosis. With such views, the collections of air are detected lying in front of or behind the heart, and also in the superior mediastinum. There the air can be seen surrounding the arch of the aorta and other great vessels and outlining them with unusual clarity. Early roentgen diagnosis is of importance in order to prevent the development of so-called "malignant" pneumomediastinum, which may be fatal.

Twenty-one roentgenograms.

RICHARD A. SILVER, M.D.
Indiana University

Pectus Excavatum: Case Report with Pre- and Postoperative Angiocardiographic Studies. Ralph A. Dorner, Philip G. Keil, and Donald J. Schissel. J. Thoracic Surg. **20:** 444–451, September 1950.

Mention on the radiographic report of findings consistent with pectus excavatum [or "funnel chest"] is probably more important than has been realized. Dramatic demonstration of objective and subjective alleviation of circulatory disability in a 28-year-old man by sternal elevation is presented, though such operations have been regarded by some as useless and hopeless. Several discussants of the paper supported the findings with personal experiences and mentioned variations of the surgical procedure.

Cardiac difficulty in the authors' case was due to impingement on the heart by the deformed sternum. The patient also suffered from bilateral bronchiectasis, presumably secondary to pressure on the bronchi by the displaced mediastinum. Preoperative and postoperative angiocardiograms demonstrated improvement in cardiovascular function, achieved by elevation of the sternum (decreased size of the right atrium, alleviation of the delay in the transit time of blood through the right atrium and tricuspid valve).

Ten roentgenograms; 4 photographs; 1 electrocardiogram.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Congenital Heart Disease. A Review of Its Clinical Aspects in the Light of Experience Gained by Means of Modern Techniques. Parts I and II. Paul Wood. Brit. M. J. **2:** 639–645; 693–698, 1950.

The clinical aspects of congenital heart disease are reviewed in the light of the significant advances made

in this field in the past few years. The author's observations are based on 233 cases referred to him in the two and a half years preceding the writing of this paper. Cardiac catheterization was done in 152 cases and angiocardiograms were obtained in 42; 44 were operated upon and 20 came to autopsy.

Six conditions made up 81 per cent of the group, namely, tetralogy of Fallot (18 per cent), atrial septal defect (17 per cent), patent ductus (14.5 per cent), ventricular septal defect (12 per cent), simple pulmonary stenosis (11.5 per cent), and coarctation of the aorta (8 per cent).

The technic of venous catheterization is first discussed from the standpoint of dangers to be avoided and reasons for failure. The implications and importance of 10 major items in the diagnosis of congenital heart disease are then considered: (1) other congenital anomalies, as arachnodactyly, (2) dyspnea, (3) cyanosis, (4) pulse, (5) venous pressure, (6) cardiac impulse, (7) murmurs and thrills, (8) second heart sound, (9) the electrocardiogram, and (10) the x-ray appearance.

Too much valuable information is given to permit abstracting. Many older ideas and impressions are corrected by the author in the light of what is known today. Concerning the x-ray appearances he says: "The most valuable recent addition to well-known radiological signs is perhaps the recognition of overfilled or underfilled peripheral pulmonary arteries. Pulmonary plethora occurs in atrial septal defect, ventricular septal defect, patent ductus, and transposition of the great vessels; pulmonary ischemia in all cyanotic cases with veno-arterial shunt, including Eisenmenger's syndrome. The difference is very obvious and does not necessarily bear any relation to the size of the pulmonary artery itself or to its main left and right branches; thus dilatation of the pulmonary artery without pulmonary plethora occurs in pulmonary valve stenosis, pulmonary hypertension, and Eisenmenger's complex; on the other hand, diminutive main pulmonary arteries occur only when the pulmonary blood flow is reduced.

"Another point of great importance is the quality of pulmonary artery pulsation: whether it is abrupt and collapsing as in atrial septal defect and pulmonary incompetence, or whether it is relatively slow-rising and sustained as in pulmonary stenosis."

Following the discussion of the various clinical features the author goes on to discuss the various commoner entities, in particular stressing diagnosis and differential diagnosis by means of physical examination as well as special procedures.

This paper is heartily recommended as an authoritative and well written summary of present day knowledge of congenital heart disease. No one interested in the subject should fail to read it in the original.

Sixteen roentgenograms; 2 electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Coarctation of the Aorta in Children. Observations in Fourteen Children. Mary B. Olney and H. Brodie Stephens. J. Pediat. **37:** 639–648, October 1950.

The authors present their observations in 14 cases of coarctation of the aorta, in 12 of which surgical repair was undertaken. Twelve of the patients were males. The ages ranged from four and a half months to fourteen years.

Group I: Five patients were hospitalized because of cardiac decompensation. All showed a precordial bulge, consisting of a forward projection of the manubrium and body of the sternum, and marked cardiac enlargement to the right and left of the sternum.

X-ray examination showed generalized cardiac enlargement; the aortic knob was poorly visualized. None of these patients showed notching of the ribs. Retrograde carotid arteriography was employed in 4 of the 5 patients. Coarctation was well demonstrated in all of them, the usual site being just distal to the ligamentum arteriosum. There was no evidence of the presence of appreciable collateral circulation. This may be of extreme importance in view of the fact that other children in this age group with coarctation and without decompensation or significant cardiac enlargement show a high degree of collateral circulation even at an early age. In 4 of the 5 children there was a definite hypoplasia of the aortic arch. The authors believe that this may be a significant factor in the causation of the cardiac failure manifested in these patients. Associated mitral valve stenosis was demonstrated in 2 of the 5 cases (necropsy findings).

There have been 3 deaths among the 5 patients in Group I. Two of the 4 patients in whom an end-to-end anastomosis was performed are classified as having excellent results.

Group II: The presenting symptoms in the 9 patients who were not hospitalized because of decompensation were related to claudication in the lower extremities produced by exercise: flushing of the face in 4 patients, acute episodes of exertional dyspnea in 3 patients, and headache and excessive fatigue in 2 patients. The physical findings in these patients were not remarkable except for hypertension in the upper extremities.

X-ray examination showed the heart to be enlarged and the aortic knob to be either small or absent in 5 cases. Notching of the ribs was present in 4 patients, the youngest aged six and a half. Retrograde carotid arteriography revealed hypoplasia of the proximal segment in 3 patients and distal hypoplasia in one. Collateral circulation was well developed in 7 patients and moderately well developed in one; in the remaining case the roentgenograms were not available. Except in one patient the coarctation was located just distal to the ligamentum arteriosum; in this patient the aorta was involved from the level of the 11th dorsal vertebra to the 1st lumbar vertebra, while the upper thoracic aorta was normal in appearance. Without a retrograde arteriogram, it would have been impossible to locate or to determine the site of the coarctation in this instance.

Of the 8 patients in Group II who had surgical correction of the coarctation, one died. Three of the patients were considered as having a good result, and 4 an excellent result.

The methods of surgical repair of coarctation are reviewed.

Thirteen illustrations, including 10 roentgenograms.

Roentgenographic Changes in Pulmonic Stenosis. A Report of Nine Cases. R. F. Healey, L. Dexter, M. Elkin, and M. C. Sosman. Am. J. Roentgenol. **63:** 813–821, June 1950.

The authors report, from the Peter Bent Brigham Hospital (Boston), 8 cases of uncomplicated pulmonic stenosis and 1 with an associated septal defect, in which the diagnosis was made by venous catheterization of the heart and pulmonary artery. A higher systolic pres-

sure in the body of the right ventricle than in its outflow tract or in the pulmonary artery established the presence of a stenosis between the high- and low-pressure areas. Physiologically significant septal defects were excluded by blood sampling from the pulmonary artery, right heart chambers, and the superior vena cava, and by the absence of arterial oxygen unsaturation in all but one case. Physiologic evidence of an overriding aorta, namely, the identity of right ventricular and systemic arterial systolic pressures, was not present in any instance. All patients were over the age of eleven. Except in the case complicated by a septal defect the condition was regarded as "mild."

Demonstrable cardiac enlargement was present in 2 of the 9 cases. Evidence of right ventricular enlargement was seen in the left anterior oblique position in 3. In only 1 instance did the right auricle appear unusually prominent. In 2 cases the left ventricle appeared enlarged on the roentgenogram, but the electrocardiogram showed definite evidence of right ventricular hypertrophy only. Left auricular enlargement was not observed. Six patients showed definite enlargement of the main pulmonary artery, which is considered the most significant roentgen finding, and in 5 of these there was definite hyperactivity of that structure.

Pulmonic stenosis may occur either at the pulmonary valve or just proximal to it in the infundibulum or the right ventricle. In a previous review (Greene, *et al.*: Am. J. Med. **6:** 24, 1949) it was shown that poststenotic dilatation of the pulmonary artery was present in 33 of 68 cases. No indisputable anatomical or physiological explanation is known for this poststenotic dilatation. Localized enlargement of the right atrium, right ventricle, and of the main pulmonary artery proximal to the area of stenosis has been well demonstrated previously.

In the authors' series, only 3 cases showed any recognizable abnormality in cardiac size or right heart configuration, and moreover in 2 of these 3 cases the right ventricular enlargement simulated left ventricular enlargement on the roentgenogram. In contrast to the minimal changes in the cardiac chambers, the pulmonary artery, as previously mentioned, showed a definite change in 6 of the 9 cases, without an associated enlargement or hyperactivity of its hilar or intrapulmonary branches. In a certain number of cases mild pulmonic stenosis may be present without producing any recognizable changes on roentgenographic examination.

The differential diagnosis depends upon the absence of associated enlargement or hyperactivity of the hilar or intrapulmonary components of the main pulmonary artery. This distinguishes the enlargement of the main pulmonary artery associated with stenosis from practically every other type of enlargement due to increased intrapulmonary arterial pressures or flow. Although this differential point is an extremely important one, there are occasional exceptions.

Sixteen roentgenograms. I. MESCHAN, M.D.
University of Arkansas

Localized Interlobar Effusion in Congestive Heart Failure. Vanishing Tumor of the Lung. William I. Gefter, Katharine R. Boucot, and E. Wayne Marshall. Circulation **2:** 336–343, September 1950.

Four cases of congestive heart failure in which localized interlobar effusion occurred are presented. The right transverse fissure is most often involved. Because the roentgen shadow is dense and variable in shape and the "tumor" disappears following diuresis and restoration of cardiac compensation, these localized effusions have been called "vanishing tumors."

Athough only about 18 cases of localized interlobar effusion have been reported in the literature, the disorder is not rare. The authors learned that, although internists are generally unfamiliar with the entity, radiologists are aware of the condition.

Hydrothorax in congestive heart failure is predominantly right-sided and the majority of the reported cases of localized interlobar effusion are also right-sided. The prerequisites for the development of such a localized effusion are (1) congestive heart failure and probably (2) obliterative pleuritis. Obliterative pleuritis prevents accumulation of fluid in the free pleural space so that the interlobar collection is visible. In 3 autopsied cases reported in the literature, the right pleural cavity was obliterated except for the fissure between the upper and middle lobes, which contained localized fluid. In another case, however, a collection of fluid in the right transverse fissure disappeared following treatment of heart failure. Five months later, bilateral effusions developed, so that the pleural cavity could not have been obliterated.

Ten roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Syphilitic Aortitis. Diagnosis by Means of Ascending Aortic Calcification. James Jackman. Pennsylvania M. J. **53:** 972–973, September 1950.

The diagnosis of syphilitic aortitis can be made from a chest examination with considerable accuracy by the roentgen demonstration of linear strands of calcification in the ascending aorta. This finding was first described by the author in a paper published in 1945 (Am. J. Roentgenol. **53:** 432, 1945. Abst. in Radiology **46:** 310, 1946). Since that time he has found 20 additional cases in which it was present, 15 of which gave a positive serologic reaction for syphilis.

Calcification in aneurysms and in arteriosclerosis is excluded. The calcification found in arteriosclerosis occurs distally on the left side of the arch and is spotty in distribution rather than stringy.

Two roentgenograms. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Transfixion of the Heart by Embedded Ice Pick Blade with Eight Months' Survival. Harry J. Lowen, Seymour A. Fink, and Milton Helpern. Circulation **2:** 426–433, September 1950.

Review of the literature revealed many reports of penetrating wounds of the heart by a variety of objects, but the percentage of cases in which the auricle alone was involved was small.

The present report concerns a 24-year-old Puerto Rican who survived for eight months following stabbing in the back with an ice pick. The broken-off blade remained impacted in the body of the sixth thoracic vertebra and transfixed the left auricle and anterior leaflet of the mitral valve. Vegetative endocarditis of the injured valve produced multiple emboli. Death followed an unsuccessful attempt at surgical removal of the ice pick.

Four illustrations, including two roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

THE DIGESTIVE SYSTEM

Tracheal Compression from Bronchogenic Cyst in Esophageal Wall. Herbert C. Maier. Am. J. Dis. Child. **80:** 423–426, September 1950.

Symptoms of tracheal compression in infancy are too frequently erroneously attributed to enlargement of the thymus gland. The author reports the case of a boy of two and a half years with labored breathing since birth. At three months of age a roentgenogram of the chest had shown a mediastinal shadow which was interpreted as an enlarged thymus. At one year, nine roentgen treatments were given but there was no change in the appearance of the mass. At operation, a thin-walled cyst was found in the wall of the esophagus. The pathologic diagnosis was bronchogenic cyst. The pulmonary signs disappeared within a week after operation.

The differential diagnosis of masses in the upper mediastinum is discussed. The author points out that intramural tumors of the upper part of the esophagus often cause respiratory rather than esophageal symptoms.

Three roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Primary Lymphosarcoma of the Stomach with Five Year Survival After Operation. Clinical, X-Ray, and Gastroscopic Features. Samuel D. Kushlan. Gastroenterology **16:** 250–258, September 1950.

Primary lymphosarcoma of the stomach is said to make up from 34 to 55 per cent of gastric sarcomas, which, in turn, comprise 1 to 2 per cent of all gastric neoplasms. The five-year cure rate is much higher than for gastric carcinoma, making the differentiation important. The patients usually are well nourished and do not show the emaciation so often associated with gastric carcinoma. The blood count tends to be normal or nearly so. The disease is less predominantly one of males, and the average age is forty to fifty.

Frequently epigastric pain is the presenting complaint. Though it may simulate that of ulcer, careful analysis will often show distinguishing differences. Relief by antacids and milk may occur but is not consistent. Anorexia may appear rather late, so that weight loss is relatively slight. Vomiting is not common, but change in stool color and even tarry stools are noted. Free acid is usually present on gastric analysis.

X-ray studies show that these lesions tend to be away from the pylorus and, in decreasing frequency, involve the lesser curvature, posterior wall, pylorus, and finally the greater curvature. The tumor may be quite large and palpable without evidence of obstruction. Distortion of the gastric mucosal relief, extending upward from the pylorus with evidence of giant rugae and occasional ulceration is suggestive. Gastroscopy shows the giant rugae. The portion involved may be rigid and non-distensible. There may be one or more ulcerations of the mucosa, though these are easily hidden by the folds between the rugae and may be missed. Such ulcerations are not as extensively necrotic and as poorly defined as are those of carcinoma.

The treatment is resection. The question of preoperative or postoperative irradiation is not settled, though it is known to be less effective in the reticulum- or large-round-cell type of tumor than in the small-round-cell type.

The case reported is typical. The x-ray diagnosis was carcinoma. The gastroscopic diagnosis was probably carcinoma, possibly lymphosarcoma. At surgery the appearance was that of carcinoma. A subtotal gastrectomy was accomplished, and the pathological diagnosis was lymphosarcoma, small-round-cell type. No postoperative irradiation was given. Recovery was uneventful and the patient was in good health over five years later.

Two roentgenograms; 1 photomicrograph; 1 drawing.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Calcified Leiomyoma of the Stomach. J. Garbarini and H. P. Price. New England J. Med. **243:** 406–407, Sept. 14, 1950.

A case report of a leiomyoma of the lesser curvature of the stomach is presented. This tumor had the unusual feature of a "salt-and-pepper" appearance on the roentgenogram due to multiple calcifications. The statement is made that leiomyomas of the stomach may calcify in the same manner as those of the uterus.

One roentgenogram; 2 photographs.

EVERETT L. PIRKEY, M.D.
University of Louisville

Aberrant Pancreas. Lennart Kjellman. Acta radiol. **34:** 225–234, September 1950.

The author reports, from the Karolinska Sjukhuset, Stockholm, three unconfirmed cases of aberrant pancreatic anlage, two located in the stomach, and one in the duodenum. The site in both the stomach and the duodenum was on the greater curvature. The roentgen findings consisted in broad-based tumor-like defects with central crater-like hollows from the bottom of which fine passages extended peripherally. The latter apparently represented ducts. The tumors were sharply defined against the background, the mucosa was only slightly distorted, and the gastric wall retained its elasticity.

After the present paper went to press a fourth case with similar roentgen findings was encountered and the diagnosis was confirmed at operation.

A review of the literature indicated that it is the general belief that the roentgenologist cannot usually do more than diagnose a benign tumor, although in many cases its true nature may be suspected.

Twenty-nine roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Aberrant Pancreatic Tissue in the Gastric Antrum. A Roentgen Study. Mario Camplani. Radiol. med. (Milan) **36:** 719–726, September 1950. (In Italian)

The author describes a filling defect in the antral region of the stomach which at surgery proved to be due to aberrant pancreatic tissue. He stresses the difficulty of accurate diagnosis in cases such as this and the necessity of surgical exploration.

Four roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Treatment of Intractable Peptic Ulcer. Walter L. Palmer, Joseph B. Kirsner, and Irwin Levin. Ann. Int. Med. **33:** 590–601, September 1950.

The authors present a number of case histories illustrating the problems involved in the management of

intractable peptic ulcer. One must insist, they state, upon the objective demonstration of a marked deformity or a crater in differentiating the patient with a truly intractable ulcer from the patient with a chronic dyspepsia, nervous indigestion, irritable bowel syndrome, or depression with somatic manifestations—a functional disorder of any sort. Actual intractability is due to inability to accomplish adequate neutralization or inhibition of the acid gastric secretion, or to the presence of some complication such as stenosis. Hence the treatment must vary from patient to patient and from lesion to lesion.

Gastric ulcer differs from duodenal and jejunal ulcer in at least two important respects: the problem of cancer and the absence of hypersecretion. A failure of a gastric ulcer to heal promptly on medical management may be evidence either of intractability or of neoplasm. Unless there are strong arguments to the contrary, such a lesion should be removed surgically.

In duodenal ulcer, intractability is usually correlated with hypersecretion and stenosis. It is difficult to neutralize the acid completely during the day and practically impossible to do so during the night except for brief periods of time. Conventional methods of therapy may afford only temporary relief. Radiation therapy directed at the fundus of the stomach may be helpful in such patients, but unfortunately the amount of radiation which can be given safely is limited and the effect is extremely variable.

Vagotomy provides another approach to the problem of intractable duodenal ulcer. This operation is indicated in stenosis as well as in hypersecretion. Since a successful vagotomy decreases gastric motility as well as secretion, a posterior gastro-enterostomy should be performed with the transabdominal vagotomy. The results are more satisfactory than with the more radical and mutilating operation of subtotal gastrectomy. The incidence of recurrent ulcer following this procedure is not yet known. Certainly some ulcers will develop, for a physiologic vagotomy does not always result from what seems to be a complete anatomic vagotomy. Furthermore, the vagotomized stomach with a negative insulin test still secretes some acid; peptic activity is present, and thus ulcers may form.

Jejunal ulcers are, in a sense, all intractable. They develop, as a rule, subsequent to a posterior gastroenterostomy or subtotal gastrectomy performed for duodenal ulcer. They are rare following such procedures for gastric ulcer or in a normal stomach. Vagotomy, if complete, is the best procedure yet devised for such ulcers.

Recurrent bleeding may be a serious manifestation of peptic ulcer. Usually acute hemorrhage can be handled in the customary medical manner. Occasionally emergency surgery is indicated. If operation is performed, the bleeding vessel should be ligated; a subtotal gastrectomy is usually the most feasible accompanying procedure. If the primary site is a duodenal or jejunal ulcer, vagotomy should be considered in addition to the resection because of the high secretory rate characteristic of these lesions. Vagotomy is certainly the treatment of choice for jejunal ulcer. When medical management, radiation therapy, and vagotomy all fail, and ulcer is definitely present, further gastric resection is the only alternative available.

Six roentgenograms; 4 charts.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Use of a Preliminary Roentgenogram of the Abdomen in the Diagnosis of Congenital Obstruction of the Intestine. John H. Kneidel. Am. J. Roentgenol. **64:** 430–441, September 1950.

Because of improved methods in technic, anomalies of the gastro-intestinal tract may now be treated surgically with less morbidity and mortality than formerly. It has therefore become important to make a prompt diagnosis and the roentgenographic findings are of great significance.

The author reports a group of cases in which the preliminary film of the abdomen contributed essential information toward a final diagnosis. In one case duodenal obstruction was associated with malrotation of the colon and anomalous peritoneal bands and in another with massive volvulus of the entire midgut. The series comprises also cases of duodenal atresia, jejunal atresia, occlusion of the proximal ileum by a congenital diaphragm, associated duodenal and ileal stenosis, imperforate anus, and ileal atresia with meconium peritonitis. In addition a case of congenital right-sided diaphragmatic hernia with all of the signs of a functional gastric obstruction and a case of infantile hypertrophic pyloric stenosis are included.

Essential roentgen features seen on the preliminary film include gas-distended loops of intestine, the caliber of which is considerably widened; when this dilated intestine shows no abrupt termination and has a mottled appearance meconium ileus must be considered. A large dilated stomach, associated with less than the normal quantity of gas in the remainder of the intestinal tract, suggests high obstruction, and if a malrotation of the colon is present then volvulus of the midgut or peritoneal bands may be the cause of the obstruction.

The gravity of the situation is so great than an infant who vomits persistently, has abdominal distention, and fails to gain weight in a normal fashion should have at least a preliminary film of the abdomen followed by appropriate contrast studies.

Careful search of the intestine must be made, since about 15 per cent of congenital obstructions show involvement of the intestine at multiple sites.

Eleven roentgenograms.

JOHN S. SCOTT, M.D.
Indiana University

Duodenitis in Childhood. James B. Gillespie and Richard E. Dukes. Pediatrics **6:** 601–606, October 1950.

Six cases of duodenitis in childhood, diagnosed roentgenologically, are reported, and the literature is briefly reviewed. Peptic ulcer was suspected clinically in several of the children. The single symptom quite consistently present in duodenitis of childhood is epigastric pain, and this was present in 5 of the patients in the authors' series. The occurrence of night pain was frequent, and relief by food and alkalies was observed occasionally. Vomiting was reported in 4 of the children. There was a history of allergy in 4, and 3 were tense, high-strung, and emotional. In 2 cases there were severe associated illnesses, a chronic respiratory infection in one and acrodynia in the other.

In children the most prominent roentgen finding in duodenitis is the marked irritability of the duodenal cap noted at fluoroscopy. Little difficulty is experienced in filling the cap, but the barium is promptly propelled forward so that the cap is rarely seen fully distended. The roentgenograms show the reticular appearance due to edema of the mucosa or indentations

of the contours resulting from swollen folds seen in profile. The indentations are inconstant and change after each contraction, and are therefore not difficult to distinguish from the permanent deformities of the cap due to ulcer scars.

Recovery was prompt and uneventful in all but one patient in this series. In this case chronic duodenitis existed for a period of four years despite a medical regime considered adequate; on one occasion there was fluoroscopic evidence of duodenal ulcer and the patient is regarded as having had both conditions. The possible presence of an inflammatory lesion of the duodenum should be considered in any child with vague or ulcer-like abdominal complaints.

One roentgenogram.

Clinical Course of Idiopathic Ulcerative Colitis. Prognostic Implications. Frank C. Bone, Julian M. Ruffin, George J. Baylin, and Chester Cassel. South. M. J. **43:** 817–822, September 1950.

An attempt has been made to delineate the types of clinical course taken by idiopathic ulcerative colitis in a series of 112 patients followed for an average of five years. In this disease, in which the etiology is unknown, the course is variable and unpredictable, and for which there is no specific therapy, the authors have correlated such factors as initial severity and the roentgen and sigmoidoscopic findings with the clinical course and final result. The diagnosis in each instance was made on the basis of a characteristic roentgen and sigmoidoscopic picture.

Four types of clinical course were recognized:

1. Recovery between attacks (55 per cent).
2. Improvement between attacks (30 per cent).
3. Continuous symptoms (10 per cent).
4. Fulminating course (5 per cent).

Consideration of the proctosigmoidoscopic course revealed the following well-defined groups:

1. Normal between attacks (41 per cent).
2. Improved between attacks (40 per cent).
3. Unchanged or worse (19 per cent).

The x-ray changes considered characteristic of the disease consisted of fine serrations, alterations of the mucosal pattern, "pseudo-polyposis," rigidity and shortening of the colon. The roentgen findings at times failed to reflect the severity of the clinical picture whereas the sigmoidoscopic changes closely followed the clinical course.

It is concluded that the initial severity of the disease? age at onset, and roentgen findings bear no relationship to the type of clinical course followed.

Medical management was considered satisfactory in 39 per cent of the patients and 19 per cent recovered. In 27 per cent, surgical intervention was required, and 17 per cent died. The most common complications were arthritis, fistula, and hemorrhage. In only one of the group did carcinoma of the colon develop.

Eight graphs.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Selective Management of Megacolon in Infants and Children. C. Marshall Lee, Jr., Kenneth C. Bebb, and John R. Brown. Surg., Gynec. & Obst. **91:** 281–295, September 1950.

The authors review the literature concerning megacolon since Parry's first description in 1825 and report 5 illustrative cases.

The management of megacolon depends on the etiology and site of the lesion. There are three general types presenting different clinical, roentgenologic, and pathologic features:

(1) Symptomatic or organic megacolon (the obstruction is grossly demonstrable). In these cases the treatment is a direct attack on the obstruction.

(2) Aganglionic or achalasic megacolon (true Hirschsprung's disease). The dilatation ends in the sigmoid colon or upper rectum. The entire rectum must be removed.

(3) Idiopathic megacolon. In most of these cases non-operative methods are curative.

Fifteen roentgenograms; 8 photomicrographs.

ROBERT J. AYELLA, M.D.
University of Pennsylvania

Mesenterium Commune. H. Voegt. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 175–178, June 1950. (In German)

The classical picture of the so-called "common mesentery" shows the duodenum, instead of extending across the spine to the left side, remaining entirely on the right side of the midline, and the right half of the colon within the left portion of the abdomen, the cecum often being in the left iliac fossa. The jejunum generally lies within the right side of the abdomen, and frequently a large part of the ileum, the last ileal loop often crossing the midline and joining the cecum from the right.

This constitutes a partial situs inversus without disturbance in position of the stomach, liver, or pancreas. Cases are observed in which the colon assumes its normal place with the patient horizontal and is demonstrable in the abnormal position on the left side only in an erect view. Thus in some cases the condition is not recognized even at operation.

The congenital disturbances are brought about by a fault of rotation resulting from persistence of the common mesentery (normal until approximately the fifth month). The incomplete rotation of the small bowel back of the superior mesenteric artery and the progression of the cecum and ascending colon toward the right in the usual manner result in the positional defects described above. It is not essential in every case to observe all of the classical features, since during the rather complicated embryonic development one or another may predominate.

A case is reported and 4 roentgenograms are reproduced.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Meconium Peritonitis. Charles Hugh Maguire and William Ray Moore. Surgery **28:** 568–573, September 1950.

Meconium peritonitis is a sterile chemical peritonitis due to single or multiple perforations of the intestinal tract *in utero*, with an outpouring of meconium into the peritoneal cavity. There is no single adequate explanation for the cause of the perforation of the intestinal tract. Cases have been reported in which antepartum perforation occurred in the ileum presumably due to hypertrophy of the glands of Lieberkühn (the apices of which reached the serosa of the bowel) associated with congenital weakness of the muscle coats of the intestinal

wall. Some cases have shown an increase in the amount of lymphoid tissue at the point of perforation. Congenital bands, atresia, and volvulus are also possible etiologic factors.

The presence of meconium peritonitis should be suspected if the following findings are present:

1. Discoloration of the amniotic fluid and the presence of a fetid odor.
2. Abdominal distention in a newborn infant.
3. Vomiting and absence of meconium in the stools.
4. Roentgen evidence of flecks and streaks of calcium and the presence of free air in the peritoneal cavity.

A typical case of meconium peritonitis is presented. Two roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Biliary Dyskinesia Studied by Means of the "Peritoneoscopic Cholangiography." M. Royer, P. Mazure, and S. Kohan. Gastroenterology **16:** 83–90, September 1950.

Clinical examinations, cholecystography, and duodenal intubation cannot exclude organic lesions of the biliary tract with complete certainty. The authors (from Buenos Aires) advocate "peritoneoscopic cholangiography" as a convenient new method which gives more information than any other. The opaque solution is injected slowly (30 to 40 c.c. in three to four minutes) under peritoneoscopic guidance and the radiographs are made at one, two, and ten to fifteen minute intervals. [The technic is described in an earlier paper by Royer and Solari: Gastroenterology **8:** 586, 1947. Abst. in Radiology **50:** 425, 1948.]

The normal common duct is 3 to 8 cm. long and 2 to 8 mm. in diameter. If larger, it must be considered abnormal. Normally the hepatic and intrahepatic ducts are not seen, as the sphincter, having a lower tonus, offers less resistance than the ducts, which are full of bile. Of 86 cases studied, 27 were normal, with good filling of the gallbladder, no stones, a common duct of normal size, and patent ampulla. Twenty-one instances of hypertonic dyskinesia were seen.

While experiments have indicated that following cholecystectomy there is increase in common duct pressure and sometimes dilatation of the ducts, studies in patients without a gallbladder showed no dilatation, even though there was evidence of dyskinesia. The authors also observed several cases of occluded gallbladder—either from inflammatory changes or stones—with no dilatation of the common ducts.

If the sphincter of Oddi is more or less closed by spasm, the hepatic and intrahepatic ducts will be visualized by peritoneoscopic cholangiography. To make the diagnosis of dyskinesia there must be no demonstrable dilatation of the common ducts, visualization of the hepatic ducts, and only a small amount of opaque material going into the duodenum. The gallbladder may be normal or contain stones.

Dyskinesia was demonstrated on one patient after a fatty meal was given, in which case the normal bile ducts were not filled until forty-six minutes after the meal, when they became visible, with no dilatation of the common duct and very little medium in the duodenum. In two cases, dyskinesia was demonstrated following morphine administration.

Cases illustrating the authors' points are briefly presented.

[This article is well worth study by all radiologists dissatisfied with present cholecystography and cholangiography. The reviewer believes there must be merit in the procedure, particularly in patients with inconclusive laboratory and x-ray findings and atypical clinical symptoms. The hazards have been considered here to be as great as those of laparotomy and most surgeons have not been impressed that the information obtainable was as complete. The findings of these authors inject a reasonable doubt in that philosophy.—B. S. K.]

Eight cholangiograms.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

An Unusual Retroperitoneal Cyst Simulating a Calcified Hepatic Cyst. William H. Shull and Charles F. Wilkinson, Jr. Ann. Int. Med. **33:** 730–738, September 1950.

An unusual case of an upper abdominal retroperitoneal cyst in a 63-year-old white female, simulating a calcified hepatic cyst is reported in detail. The patient gave no history of trauma and presented no clinical or serological evidence of syphilis. There were, however, generalized arteriosclerosis and roentgen evidence of calcification of the abdominal aorta. It would appear probable, on the basis of the pathologic report, that the cyst was actually a saccular aneurysm or an encapsulated hematoma in a dissecting aneurysm, the most likely etiology being arteriosclerosis.

This case presented the classical features of obstruction of the inferior vena cava. The presence of increased pressure in the femoral, normal pressure in the brachial, and visible congestion of the flank veins pointed to a solitary abscess or cyst of the liver. The positive Ferris-Blankenhorn sign was not of differential value.

Six illustrations, including 3 roentgenograms.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

THE MUSCULOSKELETAL SYSTEM

Adult Renal Osteitis Fibrosa with Metastatic Calcification and Hyperplasia of One Parathyroid Gland. Report of a Case. E. Arthur Dreskin and Theodore A. Fox. Arch. Int. Med. **86:** 533–557, October 1950.

A case history of a 27-year-old male with renal osteitis fibrosa is presented. The clinical picture was one of renal insufficiency, metastatic calcifications, osteoporosis, pigmentation of the skin, and a palpable mass in the region of the lower pole of the thyroid on the left. A biopsy of the mass revealed hyperplasia of the parathyroid.

Roentgenographic examinations showed calcification of blood vessel walls throughout the body, multiple irregular calcified areas in the soft tissues of the lower extremities and irregular calcium deposits in the soft tissues of the hands. Huge nodular calcifications were seen in the supraclavicular and infraclavicular regions. There was a small cystic area occupying the head of the third left metacarpal. The calvarium appeared mottled, with thickening of the skull anteriorly. The kidneys were not demonstrated after intravenous injection of diodrast. A retrograde pyelogram showed bilateral

hydronephrosis and megaloureter. A fracture with deformity of the right femoral neck was noted.

Following removal of the mass of hyperplastic parathyroid tissue, steady regression of the subcutaneous calcifications and healing of the bone lesions began, despite an unchanged renal status. Death occurred in uremia after six months of observation, a year and a half after the onset of disabling symptoms.

This case corresponds closely to the syndrome of chronic renal disease, decalcification of bone, parathyroid hyperplasia, and metastatic calcification as first described by Albright and his associates (Bull. Johns Hopkins Hosp. **60:** 377, 1937). It is the eighteenth such case to be reported.

Four roentgenograms; 8 photomicrographs; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

Report of a Case of Long Standing Renal Insufficiency with Extensive Metastatic Calcifications (Renal Osteitis Fibrosa Cystica). R. T. Levin and P. D. Genovese. Am. J. Roentgenol. **64:** 423–429, September 1950.

The authors report a case of secondary hyperparathyroidism with ectopic calcifications occurring in the soft tissues, due to chronic renal insufficiency. The duration of the renal insufficiency for many years and the presence of metastatic calcification for at least eighteen years prior to death are considered unusual features not paralleled in the 29 cases previously reported in the literature.

The soft tissue calcifications were seen roentgenographically in the interarticular and periarticular portions of the shoulders, elbows, wrists, hands, hips, knees, ankles, and feet. Calcifications were also noted in the lumbar intervertebral disks, the symphysis pubis, muscle attachments to the ischia and pubic rami, in the tendinous insertions of the triceps, biceps, and quadriceps femoris, and the plantar aponeuroses. There were, besides, cystic bone changes, arterial calcifications, granular osteoporosis of the calvarium, and calcification of the choroid plexuses of the brain. It was noted that in 21 instances of metastatic calcification secondary to parathyroid tumor reviewed previously by Mulligan (Arch. Path. **43:** 177, 1947) no periarticular calcifications were described. Such metastatic calcifications are almost unheard of without chronic renal disease.

The authors point out that in secondary renal hyperparathyroidism there is usually enlargement of all the parathyroid glands. This is due predominantly to a chief-cell hyperplasia as compared with the clear-cell hyperplasia in primary hyperparathyroidism. The size of the cells does not vary greatly from normal in secondary hyperparathyroidism; it is considerably increased in primary hyperparathyroidism. Also in secondary hyperparathyroidism due to renal disease, there are an increase in serum phosphorus, normal or low serum calcium, slight elevation of the serum alkaline phosphatase, and a low CO_2 combining power.

In an addendum the authors present a second case similar to the one reported above. A roentgen skeletal survey revealed calcific masses in the left shoulder, dorsal aspects of the forearms, soft tissues adjacent to the greater trochanters and to the lateral femoral condyles, and in the soft tissues medial to the head of the left first metatarsal. In the hands extensive periarticular and subcutaneous calcifications were seen about the interphalangeal, metacarpophalangeal, and wrist joints. Osteoporosis was found only in the upper humeri.

Six roentgenograms; 3 photomicrographs.

J. A. CAMPBELL, M.D.
Indiana University

Ollier's Disease: Dyschondroplasia. Sydney G. Nardell. Brit. M. J. **2:** 555–557, Sept. 2, 1950.

Ollier's disease is characterized by the presence of persistent areas of cartilage in the diaphyses of long bones and short long bones as a result of failure of normal ossification of cartilage. Gradations of the process are observed from persistent islands of cartilage in the metaphysis and diaphysis seen only roentgenographically to large palpable masses apparent externally.

Ollier's disease is to be differentiated from Keith's diaphysial aclasis, the main feature of which is bony outgrowths due to defective tubulation in the remodeling process of the long bones during growth.

A case is reported which presented characteristic features of dyschondroplasia on one side of the body and hemangiomata more or less confined to the opposite side—the Maffucci syndrome. Malignant changes supervened.

Eight illustrations, including 5 roentgenograms.

E. KASH ROSE, M.D.
University of Louisville

Multiple Myeloma. An Analysis of Twenty-One Proved Cases. Stephen White and Arthur J. Tillinghast. Am. J. Roentgenol. **63:** 851–864, June 1950.

During the fifteen-year period between 1932 and 1947 there were 21 definitely proved cases of multiple myeloma seen in the New York Hospital. Multiple myeloma is usually defined as a malignant tumor, essentially of bone marrow, which may present itself in single or multiple foci, with a tendency to involve first the ribs, spine, skull, and pelvis, but later appearing in the liver, spleen, and lymph nodes. There is usually reported an average duration of about two years and a half, with fatal termination, after the diagnosis is made. In one large series, radiographic changes were found in 60 per cent of the cases (Batts: Arch. Surg. **39:** 807, 1939). The predominant cell, usually referred to as the myeloma cell, closely resembles the plasma cell. A leukemic phase of the disease is recognized.

The solitary form of myeloma is extremely rare and may merely be an early manifestation.

There is no characteristic clinical picture. Pain is perhaps the most constant feature. Pathologic fractures are probably frequent. Palpable tumor may also occur. Other clinical features are cachexia and profound anemia; albuminuria; Bence-Jones proteinuria; elevation of serum protein level; reversal of albumin-globulin ratio; elevation of blood calcium with the serum phosphorus usually normal or nearly so; nephrosis, with non-protein nitrogen retention due to the obstructive effect of tubular casts of the Bence-Jones protein; chronic bronchitis and emphysema; neurologic symptoms and signs related to the extent and location of the destructive bone lesions.

The roentgen findings in multiple myeloma are widely varied. There may be (1) no recognizable changes; (2) diffuse generalized demineralization of an osteoporotic type; (3) spotty, granular or stippled demineralization; (4) a lattice appearance of the trabecular pattern of the proximal portions of the shafts of the femora

and humeri; (5) sharply punched-out osteolytic lesions, especially in the skull and ribs.

The authors include 10 detailed case reports. They point out that the differential diagnosis of multiple myeloma from the osteolytic metastases of carcinoma is frequently difficult and sometimes impossible radiographically.

The outstanding symptoms and laboratory findings in this series are presented in tabular form.

Twenty roentgenograms.

I. MESCHAN, M.D.
University of Arkansas

Gaucher's Disease in Bone. J. Kulowski. Am. J. Roentgenol. **63:** 840–850, June 1950.

Gaucher's disease is a rare, familial, constitutional disorder of lipoid metabolism in which kerasin, a product of the incomplete breakdown of complex lipoids, is stored in the reticulo-endothelial system. Actually, Gaucher's cells have been found only in the spleen, liver, bone marrow, and lymph nodes. The clinical manifestations of the disease include splenomegaly, hepatomegaly, brown pigmentation of exposed skin, wedge-shaped thickening of the conjunctiva near the cornea (pinguecula), hemorrhagic tendency, leukopenia, and thrombocytopenia. The diagnosis is established by splenic or bone marrow puncture or by splenectomy, and the disease is quite compatible with a fairly normal life span.

The author reviews the literature with particular emphasis upon the bony changes in the vicinity of the hip. He then reports a case in a woman of 27 referred for orthopedic examination in 1936, after a diagnosis of Gaucher's disease had been made in 1934, by splenectomy. The chief complaints were low back pain and "sciatica." The physical and roentgen findings at this time were essentially normal and the pain was relieved by traction. In 1937 the patient sustained a pathological fracture of the left femoral neck, and in 1948 a fracture of the opposite femoral neck occurred.

The most striking skeletal changes in this case evolved over a long period of time in the left femoral head. These changes followed upon a primary minimal pathologic infiltration and pathological fracture, the residual alterations in the femoral head being presumed to have occurred secondarily on the basis of an aseptic necrosis, weight-bearing stresses, and inadequate anatomical reduction and fixation of the fragments. The changes in the lumbopelvic areas, which were not subjected to the same degrees of stress as the hip joint, were less marked. The non-stress-bearing iliac wings were remarkably resistant to the disease and resolution here was almost complete.

Changes in the lower lumbar vertebrae progressed very slowly over a period of about twelve years. The disk spaces between the last three lumbar vertebrae were definitely narrowed.

The subsequent and residual changes in the sacroiliac joints, which followed upon the more or less characteristic initial mottled appearance, resembled those which occur after infections; namely, juxta-articular increased density and tendency toward partial or complete obliteration of the joint space. As a further corollary to this may be mentioned an early "unhooking" at the symphysis on the right side, a sign not infrequently noted in infections of the sacroiliac bones and joints.

The extensive somewhat unusual changes noted in the right upper femur epitomize the lapse which may occur between an extensive skeletal lesion and clinical symptoms. The opposite obtained in regard to the initial severe low back pain and sciatica and the long period of time which elapsed before there were any roentgen changes to account for these complaints. Similarly, some years elapsed after the patient had first complained of "rheumatism" in both shoulders before skeletal changes were seen on the roentgenogram. Since there is no apparent rule-of-thumb to be followed along this line, one should regard all symptoms relative to the skeletal system as suspect until proved otherwise. By the same token, a patient known to have Gaucher's disease should have routine roentgenographic studies of the lumbopelvic areas at regular intervals.

Sixteen roentgenograms; 1 photograph.

I. MESCHAN, M.D.
University of Arkansas

Incomplete Removal of Osteoid-Osteoma. G. M. Morrison, L. E. Hawes, and J. J. Sacco. Am. J. Surg. **80:** 476–481, October 1950.

Osteoid-osteoma is a well known clinical entity. Treatment is restricted to complete removal of the central nidus by surgery. The authors report a case in which incomplete removal was followed by continuation of the symptoms.

The patient was a 17-year-old girl admitted to the hospital because of pain in the right calf muscles for one year. X-ray examination showed a localized area of periosteal new bone formation on the posterior aspect of the tibia, with a small radiolucent area in its center. At the first operation, performed on March 14, 1947, the thickened cortex was removed and the wound closed. X-ray examination the following day showed the central area to have been partially left behind. Pain persisted after operation and roentgen examination on July 11, 1947, showed the residual nidus and additional periosteal new bone formation. A second operation was performed Feb. 17, 1948, and roentgenograms were taken of the excised specimen, showing that all of the nidus had been removed. Ten months later the patient was free of symptoms.

The authors point out that incomplete removal of the nidus may or may not result in elimination of pain, but relief of pain does not always mean a cure.

The central nidus normally measures 1–1.5 cm. and may be hidden by the surrounding thickened bone. The nidus may have several forms: a radiolucent zone with or without surrounding sclerotic bone; a well-defined sclerosed center surrounded by a thin clear band of radiolucency with a thin rim or sclerosis around it and normal bone outside the latter; a solitary oval densely calcified area in normal textured bone; and, rarest of all, a double lesion with two adjacent clear oval areas.

The authors again point out the importance of taking films at the operating table to be sure of the complete removal of the nidus.

Nine illustrations, including 6 roentgenograms; 3 tables.

A. E. O'HARA, M.D.
University of Pennsylvania

Multiple Congenital Dislocations Associated with Characteristic Facial Abnormality. Loren J. Larsen, Edwin R. Schottstaedt, and Frederic C. Bost. J. Pediat. **37:** 574–581, October 1950.

Six cases of multiple congenital deformities have been separated as an entity from the confusion of congenital

anomalies. They are characterized by flattened facies, with prominent forehead, depressed nasal bridge, and wide-spaced eyes; bilateral dislocations of the elbows, hips, and knees; equinovalgus or equinovarus of the feet; cylindrical fingers that do not taper normally; occasional cleft plate, or other palate abnormalities; and occasional associated failure of spinal segmentation.

Five roentgenograms; 6 photographs.

Hypervitaminosis A. Report of a Case. Tyree C. Wyatt, Charles A. Carabello, and M. Elizabeth Fletcher. J. A. M. A. **144:** 304–305, Sept. 23, 1950.

Hypervitaminosis A was first described by Josephs in 1944 (Am. J. Dis. Child. **67:** 33, 1944). Since that time 3 cases have been reported [including 2 with emphasis on the radiological features (Rothman and Leon: Radiology **51:** 368, 1948)]. Summarizing the reported observations, the authors state that the roentgen findings are irregularity in the cortical structure and periosteal elevation with a single layer of subperiosteal new bone formation along the mid-portion of the shafts of the long bones. The ulna was most frequently involved. All 4 of the reported cases showed an increase above normal of the serum vitamin A level, and in 2 cases the serum alkaline phosphate level was abnormally high.

An additional case is reported here in a girl of three, with clinical and roentgen observations closely paralleling those described in the earlier reports. The child had been receiving approximately 400,000 to 500,000 units of vitamin A and 60,000 to 70,000 units of vitamin D daily for almost two years, in the form of percomorph liver oil. Following discontinuation of this medication, bone tenderness and irritability disappeared rapidly, and the roentgen picture of the ulnas returned to normal.

The authors refer to 7 additional cases of this syndrome reported by Caffey after their patient had been examined (Pediatrics **5:** 672, 1950. Abst. in Radiology **56:** 304, 1951).

Two roentgenograms.

EDSEL S. REED, M.D.
University of Louisville

Vitamin D Intoxication in a Child with Rheumatoid Arthritis. John S. Hyde and Julius B. Richmond. Am. J. Dis. Child. **80:** 379–389, September 1950.

The harmful effects of the prolonged administration of large doses of vitamin D in the treatment of arthritis in adults are well known, but the administration of high-potency vitamin D in the treatment of rheumatoid arthritis in a child resulting in soft-tissue calcification and renal insufficiency apparently has not been previously reported.

The authors' patient was a 12-year-old white girl who had had rheumatoid arthritis since infancy. She received an irradiated ergosterol preparation in doses of 100,000 to 150,000 U.S.P. units orally each day for five and one half years with the subsequent development of anorexia, vomiting, polydipsia, polyuria, nocturia, calcification of blood vessels, periarticular soft tissues, and of the conjunctivas and corneas, hypertension, hypertensive retinopathy and renal insufficiency. Symptoms were alleviated somewhat after discontinuance of vitamin D therapy but renal function did not improve significantly.

A review of the literature revealed no satisfactory explanation of the physiologic action of massive doses of vitamin D. The probable sequence of events is increased calcium absorption, increased serum calcium level, decreased parathyroid activity, decreased urinary phosphorus excretion, increased serum phosphorus level, supersaturation of the blood with respect to calcium phosphate, and precipitation of the calcium at abnormal sites. The calcium deposition may be found in any of the soft tissues. The blood vessels, kidneys, and lungs are especially susceptible to calcification.

Four roentgenograms; 4 photographs; 1 table.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Anatomo-Radiological Aspects of Ankylosing Spondylarthritis. P. Wettstein and G. Riotton. Radiol. clin. **19:** 325–331, September 1950. (In French)

Comparative studies of roentgenograms and histologic sections of different segments of the vertebral column show that the bamboo image of ankylosing spondylarthritis is due to ossification of the annulus fibrosus of the disk, which may completely surround the fibrocartilage. The anterior common ligament, perfectly normal throughout, even when the disk is completely ossified, covers the "syndesmophytes." Ossification of the annulus fibrosus is preceded by a necrosis of the conjunctive fibers. The "railroad track" appearance in the anteroposterior view is due to the ankylosis of the posterior articulations and to the ossification of their articular capsules.

The disappearance of all traces of inflammation does not prevent the progression of osseous ankylosis. The process appears to be a type of endochondral ossification in the regions of the posterior articulations and the disks. This condition seems to explain, at least in part, the inefficacy of treatment once the early stages of the disease are passed.

One roentgenogram; 3 photomicrographs.

CHARLES NICE, M.D.
University of Minnesota

Haemangioma of Vertebra Associated with Compression of the Spinal Cord. Olaf Brøbeck. Acta radiol. **34:** 235–243, September 1950.

The author reviews the literature on vertebral hemangioma, including Foster and Heublein's classification (Am. J. Roentgenol. **57:** 556, 1947), and reports a case from the Aarhus Municipal Hospital, Denmark.

A 16-year-old boy had experienced gradually increasing disturbances of gait for eight months. During the last two months these disturbances had progressed rapidly and five weeks before admission there was complete paralysis of both lower limbs. Roentgenograms showed the characteristic changes of hemangioma involving the body of the 7th thoracic vertebra: a net-like osseous pattern, coarse, predominantly vertical trabeculae, and a bulging of the vertebral contours. There was also involvement of the left transverse process, which was vacuolated in appearance. The neural arch was ill defined. At operation an extradural vascular tumor which had increased the volume of the arch of the 7th thoracic vertebrae, causing compression, was found. All of the intraspinal tumor was removed and postoperative roentgen therapy was given for a total dose of 4,000 r. Complete recovery followed.

Four illustrations, including 2 roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Protrusions of Intervertebral Discs. Study of Their Distribution, Characteristics and Effects on the Nervous System. J. C. Haley and J. H. Perry. Am. J. Surg. **80:** 394–404, October 1950.

The authors have attempted to elucidate the anatomy of intervertebral disk lesions as well as to correlate the protrusions of the disks with possible alterations in the spinal cord and associated sensory roots. Attention was directed primarily toward the cervical spine.

The study was made on spinal columns and cords obtained from 99 cadavers. Sixty-three per cent of the number showed one or more disk protrusions. Cervical protrusions (53 cases) were seen about twice as frequently as lumbar (27 cases), which in turn were four times as frequent as thoracic protrusions (7 cases). The fourth, fifth and sixth disks were the most frequently involved in the cervical region while the fourth and fifth (lumbosacral) were most frequently involved in the lumbar region.

About half of the cases showed multiple involvement. This again was most common in the cervical region, less frequent in the lumbar region, and rare at thoracic levels. Involvement of both cervical and lumbar disks was of frequent occurrence and in two cases protrusions were found at all three levels.

The protrusions varied greatly in size, up to 7 mm. (about one-half were less than 2 mm.). Large ones were seen most frequently in the lumbar area and were not uncommon in the cervical region. Even the smaller protrusions, however strategically located, may cause nerve root degeneration.

In the cervical region the protrusions generally took the form of transverse ridges. In the lumbar region the protrusions were mainly nodular. Both encroached on the intervertebral foramina and vertebral canal. Compression of the intervertebral disk was greater with the ridge-like protrusions than with the nodular variety and was noted to be greater in the more active portions of the spinal column.

The damage to the nervous system resulted generally from protrusions which narrowed the intervertebral foramina. The protrusions which encroached on the spinal cord alone seemed to produce only meningeal thickening. Occlusion of spinal branches of the vertebral artery or aorta also produced nervous system damage, due to the partial ischemia. The neurohistologic findings are discussed in some detail.

The authors conclude by emphasizing that the amount of damage to the nervous system depends not only on the size of the protrusion but also upon the location and type.

Nine figures; 3 tables.

NORMAN J. WINSTON, M.D.
University of Pennsylvania

Contribution to the Diagnostic Topography of Herniated Disks by the Epidural Injection of Lipiodol. Stuhl, Sicard, Forestier, and Merle. J. de radiol. et d'électrol. **31:** 535–540, 1950. (In French)

The inconvenience of subarachnoid injections of lipiodol led the authors to study epidural injection for the localization of herniated nucleus pulposus. Under local anesthesia a trocar is inserted into the sacral hiatus. Through this a ureteral catheter is inserted and pushed upward through the sacral portion of the spinal canal to a depth of 15 or 20 cm. to study the region of the fourth and fifth lumbar segments. The lipiodol is not removed and later is seen disseminated in small drops through the lower lumbar and sacral region. Only 47 of 67 attempts resulted in successful diagnostic study. In three-fourths of the successful studies conclusions concerning the presence or absence of herniated disk were obtained.

The results obtained by this method are not compared to the authors' results with subarachnoid injection.

Eight roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Notes on the Retention of Pantopaque in the Subarachnoid Space. Edgar A. Bering, Jr. Am. J. Surg. **80:** 455–458, October 1950.

Between Jan. 1, 1946, and Oct. 1, 1948, pantopaque myelography had been done at the National Hospital, Queens Square, London, in 106 patients, without removal of the opaque material (up to 6.0 c.c.) from the subarachnoid space. Re-examination of 25 of these patients was possible and these were studied for residual effects. The interval following the original examination ranged from less than six months to between two and three years. Only the spinal subarachnoid space was studied. None of the patients seen had any signs or symptoms which could be charged to the retained pantopaque. Only one patient had had an acute reaction, symptoms of which disappeared after two or three days. None of the 106 patients ever reported back to the hospital for symptoms which could be due to retained pantopaque.

In 55 per cent of the patients re-examined, small drops of pantopaque had become fixed in the subarachnoid space, indicating a reaction to the material at this point. Fixation of a large mass was present in only one case. In no instance was fixation seen under two months time. In the remainder of the cases, the residual pantopaque was completely mobile within the subarachnoid space, in one case as long as thirty-four months following myelography.

By very crude approximation, it appeared that the more pantopaque injected, the greater the absorption rate. No indication of the locus or mechanism of absorption was found. Resorption took place from the fixed droplets as well as the mobile portions of the retained pantopaque.

One chart; 1 table.

ROBERT P. BOUDREAU, M.D.
University of Pennsylvania

Congenital Dislocation of the Hip in the Newborn and in Early Postnatal Life. Vernon L. Hart. J. A. M. A. **143:** 1299–1303, Aug. 12, 1950.

The concept of the pathogenesis of congenital hip dislocation has changed considerably during recent years. The dislocation is not the primary morbid anatomic feature but is secondary to delayed and inhibited ossification of the cartilaginous structures which enter into the formation of the hip joint or innominate bone and femur. The term congenital dysplasia of the hip is a logical and accurate designation of the primary state.

Complete displacement of the femoral head from the inadequate acetabulum, or dislocation, is not a common clinical problem; partial displacement or subluxation is a frequent cause of serious hip joint disability during early and late adult life. It is often unrecognized earlier and its relationship to dislocation is not appreciated.

The purpose of this paper is to describe (1) the earliest clinical observations in congenital hip dislocation, (2) the earliest roentgen features, and (3) the earliest treatment.

The clinical observations vary with each infant, but all depend upon (1) the degree of postural shortening or contracture of the adductor muscles, tendons, and fasciae, (2) plasticity of the cartilaginous acetabulum, (3) relaxation of the capsular and musculotendinous structures of the hip joint, (4) the degree of displacement of the femoral head from the acetabulum, (5) the age of the infant and the age of the femoral head displacement, (6) the degree of unilateral or bilateral hip joint dysplasia and (7) sequelae. The sign of the jerk or click (Ortolani) is the most valuable clinical observation and may be present before roentgen features are definite or certain. It is positive evidence of hip joint dysplasia with actual displacement of the femoral head from the insufficient acetabulum or a tendency to luxation.

The "jerk of entry" may be demonstrated by the following maneuver: The hips are flexed 90 degrees and the thighs are adducted slightly on the horizontal pelvis. The hips are gradually abducted by pressure of the physician's thumbs over the medial aspect of both knees while gentle pressure is also applied by the thumbs in line with the femoral shafts to obtain maximum displacement of the femoral head. Upward and medial pressure is applied by the fingers over and under the greater trochanters as the knees are spread apart and the hips are abducted and externally rotated. The displaced femoral head enters the acetabulum concentrically following a sudden audible, palpable and visible jerk, click, or snap. The sign is produced when the fovea capitis suddenly meets and rides over the acetabular ridge. It is indicative of complete and concentric reduction of the femoral head within the dysplastic acetabulum. The sign of the "jerk of exit" may be elicited by reversing the maneuver.

All roentgen dysplastic features are evidence of inhibited, delayed, and altered endochondral ossification or osteogenesis of the innominate bone and femur, with or without displacement of the femoral head from the acetabulum. Also, tilting of the pelvis and adduction attitude of the affected extremity secondary to adductor muscle shortening are almost constant observations. Delayed ossification of the cartilaginous roof of the acetabulum causes the bony acetabulum to appear flat and inadequate. Delayed ossification of the ilium and delayed ossification or closure of the ischiopubic cartilaginous juncture are obvious roentgen features. Inhibited and altered calcification or osteogenesis of the cartilaginous femoral head is also a constant finding.

The degree of dysplasia often is different in the various anatomic elements of the hip joint. Acetabular dysplasia may persist while femoral head dysplasia improves, or femoral head dysplasia may increase during the period of recovery of the acetabular dysplasia. Pelvic obliquity and adduction of the extremity are almost invariable roentgen observations secondary to the postural shortening or contracture of the adductor muscles, tendons, and fasciae.

Treatment of congenital subluxation and presubluxation of the dysplastic hip during infancy, before the function of weight bearing begins, is the secret for improving results in congenital dislocation and subluxation of the hip. Early application of the Frejka abduction pillow splint eliminates hospitalization, traction, anesthesia, manipulation, trauma, plaster immobilization, and the use of passive abduction frames. With presubluxation and subluxation, manipulation of the hip is unnecessary. If dislocation has occurred, this is reduced by Ortolani's maneuver, described above, and the reduction is maintained by the Frejka splint in the younger infants or by a rigid short spica in the older ones.

Eleven illustrations, including 4 roentgenograms.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Osteochondritis Dissecans of the Head of the Ulna. Johannes Thoms. Acta radiol. **34:** 161–165, September 1950.

More than 85 per cent of the reported cases of osteochondritis dissecans are said to involve the knee joint. The next in order of frequency is the capitellum of the humerus. Other sites are seldom affected.

The author states that osteochondritis dissecans of the head of the ulna apparently has not been previously reported. He presents the case of a 13-year-old girl who had suffered a greenstick fracture of the distal portion of the radius three years previously. At that time no abnormalities of the ulna were noted. Ever since the injury there had been occasional pain in the wrist following lifting of heavy objects. The present examination followed a fall from a bicycle the previous day. The wrist became swollen and painful. Roentgenograms showed a semicircular defect in the joint surface of the head of the ulna which was interpreted as osteochondritis dissecans. The author believes that trauma plays the most important role in the etiology of osteochondritis dissecans.

Four roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Growth and Development of Negro Infants. Relation of Birth Weight, Body Length and Epiphysial Maturation to Economic Status. Althea Kessler and Roland B. Scott. Am. J. Dis. Child. **80:** 370–378, September 1950.

In order to determine the effect of economic status on birth weight, body length, and osseous maturation, the authors took roentgenograms of the knees of 300 newborn Negro infants. The distal femoral and proximal tibial epiphyseal centers were chosen for study because these begin to calcify a few weeks before or after term.

For evaluation of economic status patients were grouped according to hospital pay status as follows: (1) private patients delivered by members of the obstetric staff, (2) patients in the ward service who were paying for hospitalization, and (3) indigent patients.

No consistent variation of weight, length, or size of epiphyses with economic status was found, and comparison of the groups whose mothers had either adequate or inadequate milk intake during pregnancy showed hardly any difference in body dimensions or size of ossification centers.

Previous observations of the relation of epiphyseal maturation to birth weight, body length, and sex were confirmed. The mean size of both centers increased with increasing birth weight and crown-heel length. The centers were definitely larger in girls than in boys of the same weight or length. This sex difference was less apparent in the larger infants. The femoral center was

present in 96 per cent of the girls and 92 per cent of the boys. The tibial center was present in 74 per cent of the girls and 67 per cent of the boys.

Nine charts; 1 table.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

GYNECOLOGY AND OBSTETRICS

Roentgen Diagnosis of Primary Tubal Carcinoma (With 35 Per Cent Perabrodil). E. Antonowitsch. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 189–194, June 1950. (In German)

Although carcinoma of the fallopian tube is rather rare, comprising only 0.6 per cent of genital carcinomas, with a total of some 300 cases reported in the literature, the diagnosis is extremely important if assistance is to be offered. Very often the condition is recognized too late to hope for cure. In the entire reported group only 4 patients are known to have survived beyond the fifth year with no recurrence. Delay in diagnosis is due in most cases to the resemblance to an inflammatory process.

Diagnosis is hinted at by a history of colorless or yellow discharge, usually on arising in the morning, in a patient between forty-five and fifty years of age, with vague pain radiating in various directions, a palpable mass in the region of the tube, and often associated sterility. Pathologically the tumor may be (1) solid and attached to the tube by a stalk or (2) a diffuse papillary type of growth along the tubal mucosa.

The author uses a water-soluble contrast medium (35 per cent perabrodil), which because of its relatively low viscosity has a tendency to spread through narrower spaces than the heavier iodized oil type of medium. The resulting "relief" picture gives the impression of a solid tumor in a dilated portion of the tube; about this area are seen thin layers of contrast material between the mass and the tube walls. The other typical appearance is that of multiple light and dark areas suggesting small papillary growths within the tube lumen, the contrast material forming darker areas between these. This is associated with some degree of narrowing and irregularity of outline. Confusion may arise in differentiating this appearance from tuberculous salpingitis. The latter, however, shows fine indented frayed or fringed edges, similar to changes in adenomatosis of the tube, except for the ampullar portion, and associated rigidity of contour with stiffening and straightening of the tube.

It is believed that by the use of a water-soluble contrast medium a greater degree of accuracy may be attained and earlier diagnosis of tubal cancer may be possible.

Nine illustrations, including 7 hysterosalpingograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Roentgen Diagnosis of Tuberculous Salpingitis. Kristina Ekengren and Åke B. V. Rydén. Acta radiol. **34:** 193–214, September 1950.

Seventy-five cases of microscopically proved tubal tuberculosis roentgenologically examined and treated at Karolinska Sjukhuset, Stockholm, were studied. Ninety-five non-tuberculous cases of tubal sterility were observed as controls. It was possible to distinguish four types of salpingograms which were so characteristic of tubal tuberculosis that they permitted a roentgen diagnosis with a high degree of probability: (1) slightly dilated, club-like tubes with even contours and without mucous membrane relief, closed in the beginning of the ampulla or in the isthmus; (2) tubes closed in the isthmus or beginning of the ampulla, with an irregular or ragged contour at the point of occlusion; (3) tubes with multiple strictures in the ampulla or isthmus; (4) slightly or moderately dilated tubes with ragged, irregular contours and irregular contrast defects in the ampulla. Two other pictures were somewhat less suggestive of tuberculous salpingitis: (1) dilated tubes with hypertrophic, longitudinal, regular mucous membrane relief in the ampulla; (2) slightly or moderately dilated tubes with ragged, irregular contours and irregular contrast defects in the ampulla.

The course of tubal tuberculosis was followed in 27 cases by means of repeated salpingograms at intervals up to six years. Tubal tuberculosis heals, as a rule, with shrinking of the tuberculous tissue, which in most cases leads to multiple constrictions of the tubal lumen and finally to complete obliteration.

The authors state that salpingography with a water-soluble contrast medium does not entail any appreciable risk of activation or spreading of the disease.

Sixty-three roentgenograms; 18 photomicrographs.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

GENITO-URINARY SYSTEM

Excretory Urography versus Retrograde Urography. A Ureteral Compression Technic. J. Byron Beare and Carl A. Wattenberg. Arch. Surg. **61:** 568–582, September 1950.

The authors have found that the use of compression cones made of balsa wood mounted on a masonite board has increased the number of satisfactory urograms by 25 per cent over technics not employing compression.

Perhaps one of the most important advantages of excretory urography is that it permits a survey of the entire urinary tract and thus directs attention to the diseased portion. The procedure is useful (1) in determining renal function; (2) as an aid in the diagnosis of congenital anomalies; (3) in the study of urinary calculi; (4) in most cases of urinary tract infection, when it not infrequently reveals an underlying pathological condition; (5) in renal tuberculosis, in which it permits determination of the site and extent of involvement without the risks of cystoscopy and ureteral catheterization; (6) in investigation of the urinary tract in pregnancy; (7) in suspected injuries of the urinary tract; (8) in the diagnosis of renal tumors if sufficient function remains to permit visualization of the kidneys, with confirmation of the findings by the retrograde method; (9) in men with enlarged prostates and in patients having a uretero-intestinal anastomosis, in whom it offers the only means of studying the upper part of the urinary tract. In discussing the indications in the diagnosis of calculi, the authors contrast intravenous pyelography with ureteral catheterization and retrograde pyelography. With the latter procedures, small ureteral stones and those of low density in the pelvis and calyces may be completely obscured by the dense shadows cast by the catheter and opaque solution. Furthermore, there is the added risk of introducing bacteria into a stagnant pool of urine, such as that present behind an obstructed ureter.

The authors are at pains to point out that their practice is to combine intravenous and retrograde pyelography. The two major reasons for the latter procedure are necessity for more detailed information about the drainage system of the urinary tract and the initial visualization of the pelviocalyceal system in which the kidney is not functioning.

Fifteen roentgenograms; 1 photograph.

HOWARD L. STEINBACH, M.D.
University of California

Diagnostic Value of Lacunar Cystography. Enrique Perez Castro. J. Urol. **64:** 484–498, September 1950.

Lacunar cystography, as described in this communication from the Hospital Provincial, Madrid, combines the injection of an opaque solution and air. It is thought to be of particular value where the presence of the opaque solution alone is likely to obscure disease in the urinary bladder. For abrodil, which was originally used, the author has substituted sodium bromide. With the patient in the horizontal position, 20 c.c. of sodium bromide (40 per cent) are injected, followed by 100 c.c. of air. The opaque solution remains in the form of a pool in the base of the bladder, the remainder of the viscus being distended by air.

First used by the author in demonstrating nonopaque calculi and later for vesical neck changes, the procedure is now employed for the diagnosis of prostatic hypertrophy, bladder neoplasms, and bladder diverticula, and for differentiating the causes of vesicoureteral reflux.

Twenty-six cystograms; 2 photographs; 1 photomicrograph.

DANIEL D. TALLEY, III, M.D.
University of Pennsylvania

Congenital Polycystic Kidney Disease. Harry R. Newman. Am. J. Surg. **80:** 410–418, October 1950.

Polycystic kidney occurs as a result of failure of union of the collecting tubules and the metanephrogenic anlage. The disease may be discovered at any age. There is a recognized hereditary tendency. Pain and gross hematuria are the most common presenting symptoms. Albuminuria is a significant finding, as is impairment of renal function. One or both kidneys may be enlarged, extending across the midline or into the bony pelvis. Infection and calculi are common complications.

Abdominal roentgenograms without dye usually reveal the enlarged kidneys, while an intravenous urogram may show poor excretion, either unilaterally or bilaterally. Retrograde pyelography is the most positive diagnostic method. The cases may be roughly divided into two groups on the basis of the findings by this procedure. The first group is characterized by renal deformity and shrinkage, while the calyces are flattened, elongated, tortuous, or obliterated. These cases may be mistaken for tumor unless the findings are bilateral. In the other group there are bizarre dilatations and blunting of the calyces, with or without large renal pelves.

The author reviews 57 cases of polycystic kidney disease, in 24 of which surgical procedures were done. When polycystic disease is recognized early and the blood urea nitrogen is not elevated, the patient may be benefited by surgery if it conserves renal function.

Thirteen roentgenograms; 6 tables.

RICHARD V. WILSON, M.D.
University of Pennsylvania

Ureteral Calculus in Relation to the Border of the Psoas Muscle. Bela Gondos. Urol. & Cutan. Rev. **54:** 196–201, April 1950.

Gondos reports five instances in which a calculus lodged at the point where the ureter crosses the lateral border of the psoas muscle. In 4 of the cases kinking of some degree was demonstrable at this point on the pyelogram. The author is uncertain as to the mechanism involved; the kinking may be the primary cause of arrest of the stone at this point, or may be secondary to a periureteritis and adhesions to the psoas muscle.

Twenty roentgenograms.

A. E. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

BLOOD VESSELS

Treatment of Post-Thrombotic Syndrome by Interruption of Superficial Femoral Vein. Melvin A. Cassel. Arch. Surg. **61:** 540–553, September 1950.

The rapidity and severity with which the picture of chronic venous insufficiency due to phlebitis develops are largely dependent upon the extent of the original phlebitis and the frequency of repeated episodes in the same limb. When thrombosis is limited to superficial veins and relatively short segments, few if any permanent trophic changes occur, since collateral circulation is able to compensate for such minor degrees of obstruction. When thrombosis of a large venous trunk occurs, however, compensatory circulation is rarely adequate, and there are marked changes in the skin and the subcutaneous tissue.

Clinically the first and most frequently encountered phase in the chain of sequelae is the appearance of edema. The edema is subcutaneous and involves the foot and ankle region chiefly, although extension to the knee is not uncommon. Coincident with the edema, there may be congestion and cyanosis. Irregular areas of brown pigmentation due to deposition of hemosiderin may appear. Dermatitis in the form of eczema or erysipeloid infection is frequently present. The subcutaneous tissue becomes fibrotic, which further interferes with the poor blood supply. Ulcers occur after minor trauma or irritation.

Phlebography is used to establish the diagnosis of thrombophlebitis in the doubtful case, to determine the proximal extension of a thrombus, and to aid in differentiation between a primary syndrome of varicose vein and that due to incompetency of the deep venous system.

The phlebogram is obtained with the patient erect. Lateral roentgenograms of the thigh and lower region of the leg are obtained immediately after the completion of the injection of 30 c.c. of 35 per cent diodrast into the femoral vein in the region of the femoral triangle.

In instances of damage to the valves in the femoral vein, retrograde flow of the opaque substance is manifested by filling of the vein, which may appear widely dilated and tortuous, with numerous compensatory vessels. In many cases more pertinent information will be forthcoming if the phlebogram is obtained by injection of a superficial vein in the foot, distal to a tourniquet. Such changes as obstruction, recanalization of a thrombus, dilatation of the deep veins and varicosities of old phlebitic veins, as well as extensive collateral venous development, may be demonstrated by this technic.

Ten cases with ligation of superficial femoral veins

after long-standing thrombophlebitis are reported in tabular form. After six to eight months the results were good in 5 of the patients.

Two roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

TECHNIC

Use of the Cinefluorographic Method for Teaching Purposes. L. Reynolds, K. E. Corrigan, and H. S. Hayden. Am. J. Roentgenol. **63:** 902–914, June 1950.

The authors trace the development of the cinefluorographic method and describe the technic and equipment used in Harper Hospital, Detroit. A Zeiss f. 0.85 lens is employed. Since the allowable error in focusing this lens is in the order of 15 microns, a special large focusing disk was devised to permit minute adjustments.

In actual practice, exposure time and total exposure of the patient to radiation presented serious problems. It was found that synchronization of the output of the tube with the shutter time of the camera was less satisfactory than making technical changes in the camera apparatus. Consequently, a shutterless camera was constructed with the aid of Eastman Kodak Company, requiring only one millisecond to shift the film. At this rate there is no blurring of the image and no exposure can occur between frames. A synchronized arrangement can be employed—and is preferred—for slow body motions such as ordinary peristaltic action of the stomach. The camera and its track are enclosed in a light-tight box with removable sides having special armholes to permit manipulation without exposing the apparatus to the light. Two screen sizes are used, 14 × 17 inches and 10 × 12 inches. It was found absolutely necessary to utilize a lead glass between the screen and camera.

For all practical purposes, a tube having a target of 3.2 mm. is the smallest required. The technical factors are 115 kv., 50 ma., distance 90 cm., with a 3-mm. celluloid filter. With these factors, 1.6 r per second are delivered to the patient's back.

In the final portion of this article films are reproduced showing aneurysm of the ascending aorta, a patent ductus arteriosus in a child, and mitral stenosis. From these illustrations one assumes that the motion pictures are at least as clear in detail as the image seen fluoroscopically.

The authors have found the technic to be an ideal teaching method, in that typical cases of all kinds may be shown to entire classes of students and the presentation of the film may be continued as long or repeated as often as may be necessary.

Fifteen illustrations.

GEORGE REGNIER, M.D.
University of Arkansas

Film-Faults Caused by Contact Between Roentgen Films During the Development. Ove Mattsson. Acta radiol. **34:** 166–176, September 1950.

Contact between two films in the developing solution, or contact between a film and the wall of the developer tank, gives rise to areas of reduced density if the contact is of sufficient duration. Such shadows may simulate pathologic findings on the roentgenograms. These faults involve only one of the two emulsion layers of the film, and in order to verify the cause both sides of the film should be examined carefully by studying the light reflection.

Nineteen illustrations, including 16 roentgenograms.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Concerning the Risks and Responsibilities in the Use of Iodine Compounds in Radio-diagnosis, from the Point of View of the Radiologist. A. Meyers. J. belge de radiol. **33:** 270–275, 1950. (In French)

A negative sensitivity test does not necessarily mean that a given patient will not react unfavorably to iodine compounds used in diagnostic procedures. Adrenalin and other cardiorespiratory stimulants should always be available. Advanced renal disease and poor general condition of the patient should indicate caution. The referring clinician should be cognizant of the danger of occasional reaction and assume some of the responsibility of trying to avoid serious consequences.

CHARLES M. NICE, M.D.
University of Minnesota

RADIOTHERAPY

Radiological End Results in the Control of Cancer. L. H. Garland. J. Kansas State M. Soc., Cancer Supplement **51:** 63A–69A, August 1950.

The author presents a brief summary of results obtained with radiation therapy of tumors, based on personal experience and the recent literature. Four tables which represent the guiding policy in determining the method of therapy at Stanford University are presented. These divide tumors in groups according as the usual treatment of choice is surgery, radiation as an adjunct to surgery, or radiation, with a fourth group in which radiation is rarely indicated.

Some specific accessible types of carcinoma are taken up in more detail. These include lesions of the skin, lip, tongue, and cervix. A group of inaccessible tumors (larynx, lung, ovary, and the lymphoblastomas) is also discussed.

The author emphasizes that in suitable cases permanent cure can be obtained by radiological means alone. As with surgical methods, best results are obtained in the accessible group of tumors. The use of therapeutic methods of proved value in the areas where they are most useful must be encouraged.

The article does not discuss therapeutic technics in detail, since it was presented primarily to general practitioners.

Four tables.

GEORGE R. KRAUSE, M.D.
Mt. Sinai Hospital of Cleveland

Rhabdomyosarcoma of the Maxillary Antrum. Seven Year Survival Following Surgical Excision and Radiation Therapy. Peter N. Pastore, Philip F. Sahyoun, and Frederick B. Mandeville. Arch. Otolaryng. **52:** 942–947, December 1950.

A case of rhabdomyosarcoma of the right maxillary antrum in a 46-year-old Negro is reported. The tumor filled the antral space and had destroyed the floor of the orbit and the entire bony structure of the right antrum

except for the infraorbital ridge and the medial third of the anterior floor of the hard palate.

The mass was removed surgically through an extended Caldwell-Luc type of mucous membrane incision. After all grossly visible abnormal tissue had been removed, 100 mg. of radium element in two 50-mg. capsules with 0.5-mm. platinum filter were placed in the space for ten hours for a total of 1,000 mg. hr. The patient also received high-voltage roentgen therapy (200 kv., 20 ma., 50 cm. distance, a filter of 2 mm. copper and 1 mm. aluminum, half-value layer 2 mm. copper) to one anterior and one lateral portal, each 3 cm. square; 200 r (measured in air) were delivered to each portal twenty times in twenty treatment days, totaling 4,000 r to each portal. This gave a tumor dose varying from 4,000 to 6,000 r at the operative site.

When last seen, after a period of seven years, the patient was free of demonstrable recurrence or metastasis of the original lesion.

Three photomicrographs.

HOWARD L. STEINBACH, M.D.
University of California

Carcinoma of the Cervix. Grant Beckstrand and S. W. Ellery. California Med. **73:** 248–249, September 1950.

With the increasing popularity of surgery in carcinoma of the cervix some confusion has resulted as to the choice of therapy. The authors of this paper believe that radiation is the treatment of choice in most instances, particularly if the lesion is of an early stage, although radical operation is indicated in certain rare early cases in which delivery of an effective dose of radiation to involved areas is technically difficult.

Results are reported for 107 cases treated by a combination of roentgen rays and radium. The authors use external roentgen therapy first, to reduce the size of the tumor and to combat associated infection. Five-year arrests were obtained as follows: in 22 Stage I cases, 70 per cent; in 31 Stage II cases, 55.7 per cent; in 33 Stage III cases, 39.7 per cent. No five-year cures were obtained in Stage IV cases by irradiation alone. For 18 patients irradiated following hysterectomy, for whom the stage of the disease was unknown, the five-year arrest rate was 52 per cent.

Instead of sending the early cases to the surgeons the authors believe that Stage III and IV cases are the ones which should have radical surgery. [We doubt if many radiologists or surgeons would agree to this. Radiation should at least be tried in advanced cases before recommending pelvic evisceration. Z. F. E.]

Three tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Response of Carcinoma of the Cervix Uteri to Fractionated Radium and Roentgen Therapy Given Concurrently. Howard B. Hunt. Am. J. Roentgenol. **64:** 446–464, September 1950.

The present paper is a review of carcinoma of the cervix uteri and its response to fractionated radium and roentgen therapy, based on 323 consecutive unselected cases, 254 of which were treated by the Department of Radiology at the University of Nebraska Hospital, while the other 69 were treated in private practice. Three hundred and thirteen patients (97 per cent) were followed five years or more. The 10 lost patients are counted as dead. The statistics given are in terms of absolute known five-year survivals without reference to whether or not disease subsequently developed.

The treatment of carcinoma of the cervix uteri by the Department of Radiology at the University of Nebraska Hospital began in 1931. The cases included in this review cover the span from 1931 to 1944. The absolute five-year survival rate rose from 20.5 per cent for 1931–1936 to 42.1 per cent for 1937–1941, and in 1942–1944 declined to 31.6 per cent. In the private practice group, an absolute five-year survival rate of 66.7 per cent was obtained.

From 1931 to 1936, 73 relatively advanced cases were treated by radium alone. The definite improvement of five-year results in the ensuing five years, 1937–1941, is attributed to more effective application of combined radium and roentgen therapy. The transient decline to 31.6 per cent in 1942–1944 was not believed to be representative and was regarded as due to poorer case material and insufficient supervision related to wartime conditions. This seems to be borne out by a subsequent upward trend of three-year survival rates from an average of 45 per cent to 58 per cent in 1945 and 64 per cent in 1946. The superior five-year survival rate in the private practice group is attributed to favorable case material and effective integration of radium and roentgen therapy.

The author believes that concurrent or alternating consecutive administration of radium and roentgen therapy builds up a more effective biological dosage in the parametria than when roentgen and radium are separated by an interval of days; also that fractionated application of radium permits more effective distribution of dosage, greater individualization, and fewer complications. He feels that irradiation of the parametria by radium is most effective when applied early, prior to shrinkage of the vaginal vault, to permit placement as far laterally as possible, although at a distance of 8 mm. or more from the vaginal mucosa.

A modified vaginal colpostat is described which provides better control in its placement, greater adaptability in application, variability in size, more security in immobilization, more anatomical positioning, and quicker loading, than other applicators. A plan is proposed for individualized protection of the zone intensively irradiated by radium against excessive roentgen therapy by means of individually patterned isodose shields and their proper superimposition on the abdominal wall. A simple internal pelvimeter and internal pelvic localizer are described.

Ten illustrations; 3 tables.

F. R. MCCREA, M.D.
Indiana University

A New Colpostat for the Radium Treatment of Carcinoma of the Cervix. S. DiPalma. Am. J. Obst. & Gynec. **60:** 680–683, September 1950.

The treatment of cancer of the cervix is primarily a radiological problem. This fact has been well established ever since Regaud's contribution to this branch of therapy in the 1920's, at which time he and his coworkers designed applicators to irradiate the cervix and parametrium from the uterine cavity and from centers of activity placed in the lateral fornices and against the external os. The original Regaud applicators consisted of one uterine tube activated from the fundus down to the external os and three corks to accommodate a radium or radon capsule. One cork was placed in each lateral fornix and the third cork against the external os.

During the past ten years there has been used in this

country a colpostat of Ametal rubber holding two ovoids for the lateral fornices, with the third ovoid and uterine tube incorporated in an applicator of the same material in the form of an inverted T. The author has made use of this inverted T and added to it two Ametal rubber arms carrying the two lateral ovoids, so that all the centers of activity are contained in a single applicator. The Ametal rubber arms are of sufficient thickness to provide the necessary rigidity to prevent positional changes, but are thin enough to permit bending back at the time of insertion in the vagina. The proper position of the applicator is maintained throughout the treatment period by packing, and the applicator remains in position because its design does not permit rotational motion or lateral displacement.

The author commonly uses a distribution of radium in accordance with the original Regaud method as follows: three tubes of 10 mg. each in the uterine tube; one tube of 5 mg. in the cross ovoid at the external os; one tube of 10 mg. in each lateral ovoid.

Doses of 8,000 to 10,000 mc. hr. over periods of from six to ten days are employed. This means continuous application without interruption. With supplemental antibiotics to forestall temperature rise due to poor drainage, the applicator need be removed only once during the application. It is sterilized and immediately reinserted.

The amount of radiation at the vaginal wall remains within tolerance limits with the dosage and distribution described, while the dose at the cervix is three to four times the accepted cancer lethal dose of 6,000 gamma roentgens. No damage is done at the cervix, as it can absorb extremely high dosages.

In the author's experience there were no intense radiation reactions following this technic. The applicator is easily handled and can be inserted accurately by anyone versed in gynecological procedure.

Five illustrations. ROBERT H. LEAMING, M.D.
Jefferson Medical College

The Value of Vaginal Cytology in Observing the Progress Under Radiation Treatment of Patients Suffering from Cancer of the Cervix. G. C. Maloney. Am. J. Obst. & Gynec. **60:** 533–536, September 1950.

The author reports on a study of 54 proved cases of carcinoma of the cervix, seen at the Ontario Institute for Radiotherapy, Toronto General Hospital, and followed carefully with repeated vaginal smears during the course of radiation treatment. All smears were prepared according to the technic of Papanicolaou; material was secured by a suction aspirator from the posterior fornix of the vagina.

It was proposed to attempt to predict during treatment the radiosensitivity of the tumors and the immediate efficacy of irradiation. Particular emphasis was centered on Stages I and II, the object being to find a method whereby the radioresistant tumors which are not identifiable until clinical spread demonstrates their presence can be recognized before such spread has occurred.

When the vaginal smear was devoid of malignant cells before the twentieth high-voltage treatment and remained negative subsequently, and the clinical course of the patient remained satisfactory, correlation between response to therapy and the clinical course was said to exist. Correlation was also claimed when the smears remained positive and the clinical course was unsatisfactory.

Thirteen cases of Stages I and II were followed and in all cases where the initial smears were positive, correlation existed with the clinical course of the disease. Forty-one cases of Stages III and IV were evaluated, and in 66 per cent of those cases in which a positive initial diagnosis was made by the vaginal smear method, correlation existed.

This is a small series of cases and the percentage of error is too great to permit conclusions. However, the author feels that it offers some evidence that the use of repeated vaginal smears during radiation therapy for carcinoma of the cervix is worth while and that perhaps those patients who are not showing adequate response to radiation therapy and who are still suitable for surgery could be selected after a short trial of irradiation and the salvage rate thus be increased by appropriate operation in early cases confined to the cervix.

Three tables. ROBERT H. LEAMING, M.D.
Jefferson Medical College

Time, Site, and Treatment of Recurrences of Endometrial Carcinoma. William F. Finn. Am. J. Obst. & Gynec. **60:** 773–782, October 1950.

The author has made an exhaustive study of 266 patients with carcinoma of the endometrium treated during a sixteen-year period at the Women's Clinic of New York Hospital from 1933 to 1949. In 49 of this number there was persistence or recurrence of cancer after varying intervals. In 42 cases this interval was less than three years, but in 5 (6.6 per cent of 74 patients followed for more than five years) it exceeded five years. From the author's figures it would seem possible to employ three years as a criterion of relative safety with the realization that the rate of recurrence thereafter approximates 1 per cent annually. The need for frequent examination during the remainder of the patient's life is obvious.

Three main factors influence the recurrence of endometrial carcinoma: treatment, the anatomical extent of the carcinoma, and its histologic grade.

The basic treatment at the New York Hospital is surgical, unless there are restrictive contraindications. This was formerly preceded by radium insertion but the presence of residual carcinoma in 75 per cent of the patients so treated has led to the virtual abandonment of this procedure. X-ray irradiation is usually administered postoperatively if the carcinoma has extended beyond the endometrial cavity or is of a high histologic grade of malignancy. Combined x-ray and radium irradiation is the sole method of treatment when absolute surgical or medical contraindications to operation exist.

The lowest recurrence rate followed hysterectomy alone. This, however, does not indicate superiority of hysterectomy alone but merely confirms the fact that the most favorable carcinomas, of low histologic malignancy and of limited anatomical extent, were so treated. There is a direct correlation between incidence of recurrence and the anatomical stage as well as between the average time of recurrence and the histologic grade. Undifferentiated cancers had a recurrence rate which was five times as high as that for the differentiated lesions. In general, early carcinomas showed a low incidence and a late appearance of recurrence. The advanced carcinomas had a high incidence of recurrence, and this took place early.

The most common sites of recurrence were the remaining pelvic organs, the vagina, the bladder, the

ureters, the pelvic lymph nodes, and the pelvic peritoneum. The same anatomical distribution of recurrence was present regardless of the treatment, the anatomical extent, or the histologic grade. The vast majority of recurrences were local, and the most common site was the vaginal vault. The submucosal location of these metastases, their occasional late appearance, and the presence of carcinoma cells in the vaginal lymphatics favor lymphatic extension as a more adequate explanation of vaginal recurrences and indicate the need for a more extensive removal of the upper vagina at the time of hysterectomy. The resultant shortening of the vagina does not constitute a valid objection to this procedure.

Unsuspected carcinoma of the endometrium was discovered after subtotal hysterectomy had been performed in 4 patients. This experience indicates the desirability of removing the cervix if an unsuspected carcinoma of the endometrium is found after subtotal hysterectomy has been done.

It is concluded that a more extensive hysterectomy with wider parametrial excision, more vaginal extirpation, and occasionally with pelvic node dissection, would lower the recurrence rate. No recurrences were cured by x-ray or radium irradiation. Extensive pelvic surgery for solitary, localized recurrences has shown encouraging results, even though the number of patients so treated is small.

Two roentgenograms; 2 photomicrographs; 1 chart; 5 tables.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Treatment of Infiltrating Carcinoma of the Bladder by "Retrograde Method of Interstitial Radiation." T. Brent Wayman. J. Urol. **64:** 469–483, September 1950.

A method of implanting radium needles in infiltrating bladder cancers, both operable and inoperable, is described. Seven case reports are presented with diagrams of the lesions and the anatomical structures involved in such implantations.

Depending upon the location of the tumor, the bladder is exposed by the vaginal, perineal, or suprapubic approach. Radium needles of 1, 2, and 3 mg. are used (active length 1 mg. per cm.), with 0.5-mm. platinum filtration. Surrounding structures are separated from the radium for a distance of 2 to 3 cm. by vaseline gauze strips.

Ten illustrations, including 2 roentgenograms.

JOHN F. GIBBONS, M.D.
University of Pennsylvania

Effect of Transfusions and Antibiotics upon the Duration of Life in Children with Lymphogenous Leucemia. Howard R. Bierman, Peter Cohen, James N. McClelland, and Michael B. Shimkin. J. Pediat. **37:** 455–462, October 1950.

A review was made of 103 consecutive cases of leukemia in children under fifteen years of age who were admitted to the Pediatric Service of the University of California Hospital during the period 1939–1948. This group included 90 cases classified as lymphogenous, 10 as myelogenous, and 3 as monocytic. The diagnosis was made by the usual clinical and hematological criteria, including bone-marrow examination.

The present study is devoted to the 90 cases (56 males; 34 females) of lymphogenous leukemia. Follow-up data were not available on 9 patients, and 5 additional patients were excluded for various reasons (accidental death due to puncture of a thymic blood vessel during sternal-marrow aspiration, presence of an arteriovenous aneurysm prior to onset of the leukemia, etc.). Statistical evaluation of survival is therefore based on a total of 76 patients.

The cases are divided into four groups: (1) Eighteen patients were untreated. The average survival time in this group was 5.6 months, with a range of two to sixteen months. (2) Seventeen patients received irradiation, either by x-ray or radiophosphorus, with transfusions and antibiotics at some time during the course of the disease. The average survival time was 5.8 months, with a range from three to eleven months. (3) Twenty-four patients received blood transfusions but no antibiotics, with an average survival of 6.0 months, and a range of two to nine months. (4) Seventeen patients received blood transfusions and penicillin and/or sulfonamides and survived an average of 8.9 months, with a range of three to twenty-three months.

Statistical analysis shows no significant differences in the survival period between the first three groups of patients, and it is concluded that irradiation or transfusions alone have not been demonstrated to have a significant effect upon the survival of children with lymphogenous leukemia. The mean survival period of the group of 17 patients who were treated with transfusions and penicillin and/or sulfonamides, however, is significantly greater ($P = 0.03$) than the mean survival time in any of the other three groups. The authors believe that it may be concluded with a reasonable degree of certainty that the addition of penicillin and sulfonamides and transfusions to the treatment of children with lymphogenous leukemia was associated with an increased survival period in this series.

Four charts; 2 tables.

Roentgen Therapy for Bursitis of the Shoulder. David Robinson. J. M. A. Georgia **39:** 205–209, May 1950.

Roentgen therapy for bursitis of the shoulder has withstood the test of time and each year more favorable reports are confirming the work of earlier investigators.

Many diversified opinions have been expressed concerning the etiology of this condition. Codman believed that strain and trauma produced small bloody deposits in the tendon, with subsequent calcification. Others have mentioned infection, endocrine disturbances, faulty metabolism, vitamin deficiencies, and thermal changes. Sandström and Wahlgren (Acta radiol. **18:** 263, 1937) following a thorough histopathologic study concluded that the changes were secondary to local tissue anemia and that improvement in symptoms and disappearance of the calcium deposits were due to increased vascularity.

A gross calcific deposit lateral to the greater tuberosity of the humerus is one of the most positive diagnostic criteria for a bursitis of the shoulder. Quite frequently it is necessary to make films in internal and external rotation to demonstrate the calcification, and the author believes these views should be routine in all cases of suspected bursitis. It is not necessary, however, for calcific deposits to be present in order to make the diagnosis. Other roentgen changes include local areas of rarefaction, decalcification, and trabecular atrophy. Neither the size of the calcium deposit, its presence, nor its absence determines the severity of the symptoms.

In evaluating a possible bursitis case one must rule out fractures of the humerus, neoplastic changes, inflammatory changes, herpes zoster, calcinosis universalis, angina pectoris, neuralgia, brachial plexus syndrome, cervical spondylitis, metastatic bone disease, tuberculosis, and syphilis.

The author divides his cases into acute and chronic types without a definite line of demarcation. The acute cases are treated three to six times every third day. If after the third treatment the patient shows complete relief, no further treatment is administered; if there is no response or relief is incomplete, three more treatments are given over a similar period. In chronic cases the irradiation is given at longer intervals—weekly or biweekly—for four to six treatments. The factors are: 200 kv.p., 15 ma., 0.5-mm. Cu plus 1.0-mm. Al filter, 50 cm. skin-target distance, h.v.l. 0.9-mm. Cu. Portals measure 10 × 10 cm., and the average air dose per treatment is 100 to 150 r. Treatment is given through anterior, posterior, and lateral fields.

The author reports his results in 61 cases, of which 51, or 83 per cent, showed a satisfactory response.

Five roentgenograms; 4 tables.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Use of Beta Rays in Climacteric Metrorrhagia. A Suggestion. F. Crainz. J. Obst. & Gynaec. Brit. Emp. **57:** 792–794, October 1950.

As compared with roentgen therapy for climacteric metrorrhagia, intra-uterine radium application has the advantage not only of controlling bleeding more promptly but also of producing slighter menopausal symptoms. Because a lower dose of radiation reaches the ovaries, their function is partially conserved, as is proved by the presence of follicular hormone in the blood after the induction of amenorrhea. This hormone is absent in the blood of those treated by roentgen therapy.

The author believes that the amenorrhea is caused by the local action of the radium on the endometrium, and not secondarily by its action on the ovaries. He thinks that if the ovaries were not affected at all, further benefits might accrue to the patient. He therefore proposes the use of substances producing beta radiation alone for its local effect on the endometrium and its selective sparing of the ovaries, due to its poor penetrability. He has had no experience with this method, since suitable substances have not been available in Italy, but thinks it would be a good idea if someone tried it.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

The Question of Genetic Injury Following X-Ray Irradiation of the Ovaries in the Treatment of Sterility. Ira I. Kaplan. J. Obst. & Gynaec. Brit. Emp. **57:** 767–779, October 1950.

During the past twenty-five years the author has treated 413 women for amenorrhea and sterility with roentgen irradiation, and 362 of these have been followed. In 292 normal menstruation was resumed and 168 became pregnant. No deleterious effects were seen in either the first- or second-generation progeny of the women treated.

The following factors are used: 200 kv.; 0.5-mm. Cu plus 1.0-mm. Al filter; 50 cm. target-skin distance; 8 × 10- to 10 × 15-cm. portals for the ovaries, and a 6 × 8-cm. or 5-cm. round field for the pituitary. In the first treatment the dose is 50 r (measured in air) to the anterior right and left ovarian fields, and 75 r to the anterior pituitary field. One week later, 75 r are given to the posterior right and left ovarian fields, and 75 r to the pituitary. The third treatment, after another week, repeats the first treatment.

Kaplan believes that radiation, properly administered, for the treatment of sterility is harmful neither to the mother nor the offspring.

Numerous cases are briefly presented.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

RADIOISOTOPES

Some Results from the Use of Radioactive Iodine, I^{131}, in the Diagnosis and Treatment of Toxic Goiter. Sidney C. Werner, Lawrence D. Goodwin, Edith H. Quimby, and Charlotte Schmidt. Am. J. Roentgenol. **63:** 889–894, June 1950.

The authors present a study of 175 hospital patients to compare the radioactive iodine tracer technic with the basal metabolism test in a toxic thyroid disease, and present also the results of treatment of hyperthyroidism with radioiodine in 103 patients.

The inaccuracy of the basal metabolism test is first emphasized, indicating that there is considerable room for a more accurate evaluation of the toxic thyroid patient. Of 113 normal subjects 16 per cent had uptakes greater than 35 per cent and with two exceptions these had normal or subnormal basal metabolic rates. In addition, one patient's uptake was just below the normal range, making a total of 17 per cent outside the normal limits. These studies were in response to 40 microcuries of I^{131} administered by mouth, and the uptake studies were carried out directly over the thyroid twenty-four hours thereafter. Of the 113 euthyroid individuals 32, or 28 per cent, had basal metabolism values outside the usual limits—12 high and 20 low. Of the patients with high values, all but 2 had normal iodine uptakes, while of those with low rates, 5 showed higher than normal iodine readings.

In a separate study of radioiodine uptake in hyperthyroidism involving a total of 302 patients, 6 per cent had uptakes of less than 35 per cent at 24 hours.

Whereas it is frequently necessary to repeat basal metabolism tests to rule out emotional effects, it is unnecessary to repeat the tracer-iodine study. Errors in the tracer test, however, do occur particularly as a result of previous stable iodine administration either in the form of Lugol's solution or in organic form in the dyes used in cholecystography and intravenous pyelography. Similarly, the ingestion of thyroid medication or of antithyroid drugs will interfere with the test.

The accuracy of the tracer study for toxic thyroidism is, however, felt to be considerably greater than that of the basal metabolism determination. Moreover, it is simple, acceptable to the patient, and requires less cooperation. Tracer studies alone can screen out approxi-

mately 85 per cent or more of the problems related to thyroid disease, leaving only 15 per cent for more detailed and laborious confirmatory procedures.

One hundred and three cases of thyrotoxicosis were treated with radioiodine during a three-year period. Initially a relatively constant dose of 3 to 4 millicuries was utilized. After January 1948 a wider range of dosage was adopted—3 to 6.5 millicuries. Since that date, 63 patients have been treated with a dosage level of 100 microcuries per estimated gram of gland weight. Of this group, 44 had primary unoperated toxic goiter, whereas 19 had recurrent goiters following operation. After a single dose of I^{131} 59 per cent were brought into remission and 5 per cent were made hypothyroid. A second dose was administered to the failures after a four-month interval, and this in turn brought the total in remission to 81.3 per cent while 6 per cent now had hypothyroidism. A final third dose was given, four months later, to those still not in remission, and the final total in remission following this dosage was 90 per cent, with 6.9 per cent apparently permanently hypothyroid. Thus, a total of 96.9 per cent of the group were relieved of toxicity of hyperthyroidism or were made hypothyroid. Follow-up in these cases ranged from four months to a year and a half.

Apart from hypothyroidism, complications were negligible. Malignant exophthalmos without progression occurred in 2 patients and there was a flare-up of toxicity with cardiac repercussions in 1 instance. The major drawback in radioiodine therapy for toxic goiter is the lag of two or three months before remission.

The possibility of malignant change following treatment with internal radiation is for the future to evaluate. At the present time it would seem that this mode of therapy is indicated particularly for recurrent toxic goiter following surgery, for complicated cases unsuitable for operation, and in patients with primary toxic goiter over the age of forty-five, in whom late malignant change is not too serious a consideration.

Four diagrams.

I. MESCHAN, M.D.
University of Arkansas

Use of Protein Bound Iodine as a Clinical Tool. William N. Harsha. J. Kansas M. Soc. **51:** 332–336, July 1950.

From the University of Kansas Medical Center two procedures are described to assess the degree of thyroid activity.

The first consists in the chemical determination of the protein-bound iodine and can be employed in any laboratory. It is an entirely closed technic for the release and binding of the iodine from a 25-c.c. blood sample, and is free of requirements and potential hazards involved in the use of radioiodine. It does not require expensive apparatus, and reproducible results with a margin of error of plus or minus 3 per cent have been readily achieved by several inexperienced technicians. Patients with a protein-bound iodine between 3 and 10 micrograms are considered to have normal thyroid activity. Higher levels indicate a hyperfunctioning thyroid and lower levels a depressed activity.

The second procedure, requiring more elaborate equipment, involves the measurement of the degree of conversion of radioiodine to circulating thyroid hormone. It again measures the circulating protein-bound iodine. In this procedure, appropriate amounts of carrier-free potassium iodide are administered orally—0.5 to 0.8 millicuries (Oak Ridge standard) to patients with apparently hyperfunctioning thyroids and 0.3 millicuries to those with apparently low or normal thyroid function. Blood samples are obtained twenty-four hours later, 15 c.c. being placed in 5 drops of heparin. The plasma is separated by centrifugation, and the total plasma I^{131} is determined by pipetting 1 c.c. of plasma into a small capsule and adding 1 c.c. of a diluting solution containing 0.02 M NaOH, 0.0015 M KI, and 0.005 M $NaHSO_3$. One drop of 1 mg. per c.c. of $AgNO_3$ is added. The capsule is gently agitated and dried in a hood under an infra-red lamp. The radioactivity is then determined with a Geiger-Müller counter. The activity of the plasma proteins is determined concurrently and by measuring radioactivity in the same way. The proteins are precipitated from a second sample of plasma (1 c.c.) with 4 c.c. of 10 per cent trichloracetic acid and washed with the acetic acid solution. The precipitate is then dissolved by 2 c.c. of water containing seven drops of 2 N NaOH and transferred to a capsule. Again one drop $AgNO_3$ is added and the residue dried under the same infra-red lamp. The results of the determination are expressed as the ratio of radioactivity in counts per second in the protein fraction and in the total plasma fraction. This is designated as the conversion ratio and is read as per cent of I^{131} converted.

$$\frac{\text{Protein bound } I^{131} \text{ in counts per second}}{\text{Total plasma } I^{131} \text{ in counts per second}} \times 100$$

Patients converting from 10 to 50 per cent of inorganic I^{131} to protein-bound iodine are considered as having normal thyroid activity, those converting less than 10 per cent are regarded as hypothyroid, and those converting over 50 per cent as hyperthyroid.

In summary the author states that the chemical determination of the protein-bound iodine is technically feasible and reproductive of results that concur accurately with thyroid activity, while measuring the degree of conversion of radioiodine to circulating thyroid hormone is technically simpler, less expensive in a properly equipped laboratory, and reproducible with the same degree of accuracy. Neither procedure is harmful to the patient nor does it restrict his activities. Both tests are ideally suited to follow the effect of various therapeutic procedures.

One drawing; 7 tables.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Radioactive Phosphorus. I. In the Treatment of Lymphatic Leukemia. Henry D. Diamond, Lloyd F. Craver, Helen Q. Woodard, and George H. Parks. Cancer **3:** 779–788, September 1950.

This paper is the first of a proposed series of communications reporting a nine-year experience, at Memorial Hospital (New York), with P^{32} in the treatment of lymphomas, leukemias, and allied disorders. It deals with the palliative treatment of lymphatic leukemia between April 1940 and May 1949. In this period 84 patients with lymphatic leukemia received radioactive phosphorus; 71 for whom follow-up was adequate form the basis of this report. Fifty-three cases were classed as chronic and 18 as acute. The dosage of radioactive phosphorus in the chronic group was calibrated at 0.1 mc. per kilogram of body weight, the dose being divided into individual daily doses as close to 1 mc. as possible. Thus a 70-kg. patient would be given 1 mc. daily for seven successive days.

It was recognized that some of the P^{32} administered orally always escapes absorption in the gastro-intestinal tract and is lost in the feces. Early measurements indicated that this loss amounted to only about 20 to 25 per cent, and even smaller losses could be expected with material of the high specific activity that was available later. It was noted, also, that intravenous administration, at least in 4- to 5-mc. doses, was followed by appreciable loss of P^{32} in the urine in the first day. The intravenous use of P^{32}, moreover, involved processing the material to remove pyrogens, with a slight loss by radioactive decay during the time required for the procedure. There was, in addition, a small but appreciable exposure of the laboratory and medical personnel during processing and injection, as well as considerable expense for their time. Hence, it was felt that the advantages of intravenous administration were outweighed by the disadvantages, and it was employed only twice in the entire work. With the technic used, the operator received less than 30 milliroentgens to the wrists and whole body during one month in which 100 mc. was handled.

Of the 53 patients with chronic lymphatic leukemia, only 10 were treated with P^{32} alone. Other methods used were local roentgen irradiation, Heublein (total body) irradiation, Fowler's solution, urethane, folic acid antagonists, nitrogen mustard, etc. Of the 18 patients with acute leukemia, 9 were treated with P^{32} alone. The dosage in such cases was well below that used in the chronic cases. The remaining 9 patients received cautious local roentgen irradiation in addition to P^{32}.

In no instance in the acute group could P^{32} be shown to have any beneficial effect. The average survival time was found to be 4.5 months from the onset of symptoms. In the chronic cases treated by the combination of P^{32} with other methods, the average duration of life after the onset of the first symptoms was found to be 4.2 years; there were 13 five-year survivals (as reckoned from the onset of symptoms), or 24.5 per cent. The authors agree with Lawrence, *et al.* (J. A. M. A. **140:** 585, 1949. Abst. in Radiology **54:** 800, 1950) that in these cases life may be prolonged in comfort and usefulness. They also emphasize the fact that their five-year survival rates and those of others are considerably in excess of those reported for malignant melanoma and for cancer of the esophagus, pancreas, stomach, and lung, and suggest that the undue pessimism concerning lymphatic leukemia reigning in the minds not only of the public, but also of the medical profession, should be dispelled by these figures.

Seven graphs; 5 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Lymphadenosis Cutis Circumscripta Treated with Radioactive Phosphorus. Seth S. Barnes and Thomas W. Moffatt. Arch. Dermat. & Syph. **62:** 556–561, October 1950.

A solitary nodular skin plaque developed on the bridge of the nose of a 52-year-old housewife with chronic lymphogenous leukemia. For approximately two years, the leukemia was treated by blood transfusions and roentgen irradiation of the cervical nodes, axillary nodes, and spleen, with the patient's general condition showing little change. The skin lesion on the nose, however, continued to expand; biopsy findings were consistent with the clinical diagnosis of lymphadenosis cutis circumscripta. Following the biopsy, the patient was given two intravenous injections of radioactive phosphorus (3.27 millicuries on the first occasion, and 1.09 millicuries on the second). This resulted in excellent clinical improvement, but the lesion on the nose not only failed to regress but increased measurably in size and in number of individual papules forming the plaque.

One photograph; 3 photomicrographs.

A Study of the Viability of Autogenous Frozen Bone Grafts by Means of Radioactive Phosphorus. Clifford L. Kiehn, Hymer Friedell, Jerrel Benson, Marvin Berg, and Donald M. Glover. Ann. Surg. **132:** 427–430, September 1950.

The authors removed sections of ilia from dogs, preserved them at 0° C. for from two to six months, and then reimplanted the bone in the original animal. Immediately after reimplantation the animals were given 200 microcuries of radioactive phosphorus, intravenously. At varying intervals the grafts were removed, together with samples of intact ileum, and assayed for radioactive phosphorus content. Similar tests were made with bone removed from the freezer and then boiled prior to implantation.

The rate of utilization of P^{32} in the frozen bone so closely approximated that of the intact bone of the dog that the authors concluded that frozen bone chips can remain viable and retain the metabolic properties of normal bone, when reimplanted in the donor, two to six months later. Boiled bone did not manifest this property.

One graph; 1 table. A. E. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

Uptake and Distribution of Radioactive Phosphorus in Chicken Eggs Containing a Rapidly Growing Mammary Tumor of a C3H Mouse. Irving Galinsky. Cancer Research **10:** 642–643, October 1950.

A C3H mammary carcinoma was grown in fertile chicken eggs by the yolk-sac-injection technic. Eight days after tumor inoculation radioactive phosphorus in a 1 per cent Na_2HPO_4 solution was injected between the chorio-allantoic membrane and the egg shell. The radiophosphorus was found to be taken up by the blood stream and distributed throughout the egg. At forty-eight hours most of it had been excreted into the allantoic fluid. The tumor took up more radiophosphorus than either the embryo brain or liver. The embryo skeleton accumulated radiophosphorus more rapidly than the tumor and at ninety-six hours after injection contained about five times as much.

Studies on the Distribution of Radioactive 8-Azaguanine (Guanazolo) in Mice with Eo771 Tumors. Leonard L. Bennett, Jr., Howard E. Skipper, Jack H. Mitchell, Jr., and Kanematsu Sugiura. Cancer Research **10:** 644–646, October 1950.

Studies with 2-labeled 8-azaguanine (guanazolo) in normal and mammary adenocarcinoma-bearing mice have shown that very little of the 2-carbon atom is oxidized to carbon dioxide and exhaled, but that most of this atom is excreted in the urine. No evidence was obtained that the compound in question (or the 2-carbon therefrom) was preferentially accumulated, fixed, or incorporated in Eo771 tumors, which are known to be inhibited by 8-azaguanine.

Distribution of Radioactivity Following the Feeding of Carbon-14-Labeled 2-Acetylaminofluorene to Rats. Harold P. Morris, John H. Weisburger, and Elizabeth K. Weisburger. Cancer Research **10:** 620–624, October 1950.

The distribution of radioactivity was studied in rats two and six hours following oral administration of a single dose of 2-acetylaminofluorene-9-C^{14} and six hours following a dose of 2-acetylaminofluorene-ω-C^{14}.

A considerable quantity of the radioactivity of 2-acetylaminofluorene-9-C^{14} was absorbed within two hours, with detectable quantities present throughout the body of the rat. A wide distribution of radioactivity was also noted at six hours after administration of either compound. However, the path taken by the radioactivity of the 9-labeled compound was different from that of the methyl-labeled derivative. Less of the latter was excreted in the urine, and more was found in the organs and tissues.

Six per cent of the administered radioactivity from 2-acetylaminofluorene-ω-C^{14} was eliminated in the breath within six hours, while negligible amounts of radioactivity from the 9-C^{14}-labeled compound were expired during the same period, which supports the view that the acetyl group of 2-acetylaminofluorene is split off by the rat, at least in part, and metabolized independently of the remainder of the molecule.

Investigation of the Nucleic Acids of Viscera and Tumor Tissue from Animals Injected with Radioactive 8-Azaguanine. Jack H. Mitchell, Jr., Howard E. Skipper, and Leonard L. Bennett, Jr. Cancer Research **10:** 647–649, October 1950.

Radioactive carbon from carbon-labeled 8-azaguanine, at six and twenty-four hours after injection, is found in higher concentrations in the nucleic acid fractions of normal viscera and of Eo771 tumor tissue than in the tissues from which the nucleic acids were isolated.

The nucleic acid fraction from Eo771 tumor tissue is no higher in radioactivity than the nucleic acid fraction from normal visceral tissue.

It is shown that 8-azaguanine is present in the purines isolated from the ribosenucleic acid fraction of visceral tissue of animals injected with radioactive 8-azaguanine.

Two tables.

RADIATION EFFECTS

Leukemia in Radiologists in a 20 Year Period. Herman C. March. Am. J. M. Sc. **220:** 282–286, September 1950.

This report on leukemia in radiologists supplements one made by the same author in 1944 (Radiology **43:** 275). At that time he reported a high incidence of leukemia in radiologists, as compared to non-radiologic physicians. The present paper covers the years 1944 to 1948, inclusive. The basis for the report is the obituary section of the J. A. M. A. In the period covered 15,762 deaths were reported, 124 of these in radiologists. The incidence of leukemia for the non-radiological physicians was 0.72 per cent; for radiologists, 4.84 per cent. These figures are comparable to those of the previous report. By applying a statistical analytic evaluation, it is found that there is only one chance in a billion that the increased incidence is due to coincidence.

It is concluded that either the occupational hazard is not sufficiently appreciated, that standard methods of protection are insufficient, or that these methods are too difficult to employ correctly in routine work.

One table. PAUL W. ROMAN, M.D.
Baltimore, Md.

The Tonsil After Radium Irradiation. Ernest J. Van Eycken. Ann. Otol., Rhin. & Laryng. **59:** 648–649, September 1950.

The tonsils of a 52-year-old woman were removed twenty years after radium irradiation. One radon seed had been inserted into each tonsil for three days. Since each seed gave off 55.6 mc. hr. daily, a total of 166.8 mc. hr. to each tonsil had been received. The histopathological findings are reported.

The stratified squamous epithelium of the free surface was mildly hyperkeratotic. The lymphatic elements showed moderate hyperplasia with an increase in the number of germinal centers. Many mononuclear phagocytes were scattered throughout the sinusoids. Fibroplasia with a dense proliferation of scar tissue was a prominent feature, replacing parenchymatous tissue. Occasional islands of metaplastic hyaline cartilage were encountered within the fibrous tissue. The vessel walls appeared generally thicker than usual, with narrowing of their lumina. The diagnosis was atrophy of tonsils with probable radiation sclerosis.

These findings are held to support the contention that surgical excision is more satisfactory than irradiation.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Platelet Values in Personnel Engaged in Roentgen Diagnostic Work. Harry Mossberg. Acta radiol. **34:** 186–192, September 1950.

In healthy persons the blood platelets are very resistant to external factors such as fever, infection, and exertion. A low platelet count in an otherwise healthy individual in radiologic work must, therefore, be considered as a radiation effect.

The author made platelet counts on 24 members of the staff of the roentgen diagnostic departments of the Södersjukhuset, Stockholm, and on 16 controls who had never done radiologic work or had been engaged in it for a few months only. He found a definite decrease in the platelet count in about one-third of the radiologic personnel. Because of his observations, he is of the opinon that the platelet count should be used as an integral part of the routine blood control of personnel in a department of radiology.

One graph. RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

A Calibrated Roentgen-Ray Film Badge Dosimeter. E. Tochilin, R. H. Davis, and J. Clifford. Am. J. Roentgenol. **64:** 475–488, September 1950.

A film badge dosimeter is described which utilizes the principle of direct determination of effective wave length. This involves two measurements: the intensity of the beam is measured, a metal absorber of known thickness is placed between the beam and the ionization chamber, and the intensity of the beam is again meas-

ured. From the percentage of beam absorbed by the metal it is possible to calculate the wave length of a monochromatic beam which will suffer the same amount of absorption. This is defined as the effective wave length.

If two films, one of which is covered by a metal shield, are exposed to the same beam, and this experiment is repeated with different effective energies, there is found to be a density ratio between the uncovered and the shielded film. This ratio is a function of the roentgen-ray energy. Since this is a quantitative relationship, the effective energy can be measured by determining these ratios. The film badge dosimeter was constructed for this purpose and is practical as long as the measurements are within the energy dependent region. It is divided into four areas, one area is unshielded and the other three covered with metal shields of different types and amounts of metal.

Details as to film requirements and developing technics are given and tables and graphs are furnished for complete utilization of the procedure.

J. DURLACHER, M.D.
Indiana University

Influence of Ovarian Function on Incidence of Radiation-Induced Ovarian Tumors in Mice. Henry S. Kaplan. J. Nat. Cancer Inst. **11**: 125–132, August 1950.

Tumors have long been known to develop in the ovaries of mice exposed to x-rays. It is also known that tumors will develop in non-irradiated ovaries that are grafted into the splenic or pancreatic tissue of gonadectomized rats and mice.

The mechanism by which irradiation leads to the development of ovarian tumors has attracted considerable interest. It is possible that such tumors may result from the *systemic* effect of whole-body irradiation or from *local* action upon the ovary, or from both. A number of investigators have presented evidence indicating that such development of tumors is at least partially the result of a hormonal imbalance. It has been postulated that estrogens secreted into the portal circulation by the ovarian grafts are inactivated by the liver, with presumptive depletion of systemic circulating estrogens and secondary hypersecretion of pituitary gonadatropic hormone. Prolonged stimulation by pituitary gonadatropic hormone is thought to result in hyperplasia and ultimate neoplasia of the ovarian grafts.

Lick, Kirschbaum, and Mixer (Cancer Research **9**: 532, 1949) found that local irradiation of a single ovary yielded a neoplasm in that ovary only when the opposite ovary was excised or also irradiated. This paper presents the confirmatory results of a quite different experiment designed to study the same problem.

Four experimental groups of mice were used. Three variables—(*a*) irradiation of the host, (*b*) *in vivo* irradiation of ovarian grafts, (*c*) ovariectomy—were manipulated in an attempt to evaluate possible direct and indirect, and local *vs.* systemic, effects of irradiation on ovarian tumor induction.

Irradiated ovaries implanted intramuscularly into irradiated and non-irradiated groups of spayed LAF_1 hybrid mice gave rise to many granulosa-cell tumors, luteomas, and related neoplasms. No such tumors occurred when irradiated ovaries were implanted into non-irradiated, non-ovariectomized mice. Non-irradiated ovarian grafts in irradiated, spayed animals yielded only one sarcoma (3 per cent) that could not be said to have originated in ovarian tissue. Cyclic vaginal smears were consistently observed in selected animals of the latter two groups, whereas anestrous smears occurred initially in 15 of 18 mice of the tumor-bearing groups, giving way within about four months to cyclic or persistently cornified smears in 11 of these.

It is concluded that intact ovarian endocrine function inhibits the development of tumors in irradiated ovarian grafts, confirming the reported observations of Lick, Kirschbaum, and Mixer. The significance of these results is discussed in relation to other available evidence, and it is suggested that both a direct and an indirect mechanism are involved in the development of tumors in irradiated mouse ovaries.

Two tables. DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Effects of Ionizing Radiations on a Transplanted Lymphosarcoma. Joanne Hollcroft, Egon Lorenz and Harriet Hunstiger. J. Nat. Cancer Inst. **11**: 1–16, August 1950.

This paper reports the results of a series of experiments dealing with the effects of irradiation on a transplanted mouse lymphosarcoma. The experiments were designed to investigate the effect on this tumor of whole-body roentgen irradiation as compared with the effect of the alpha particles from radon and its decay products administered intravenously in comparable energy doses as determined in previous experiments, and, in addition, to examine the role of the systemic response to irradiation in regression of this tumor. The various investigations covered: (1) administration of different doses of x-ray and radon to the animals and comparison of the effects; (2) effect of tumor size on tumor regression; (3) direct and indirect effect of irradiation on the tumor; (4) effect of whole-body irradiation on the tumor with various organs such as the spleen and thymus shielded. The results are presented in charts and tables.

When the effect of whole-body roentgen irradiation on a transplanted lymphosarcoma was compared with the effect of alpha radiation of radon and its short-lived decay products injected intravenously, little difference was noticed grossly in the regression curves.

Tumor regression, *i.e.*, the amount of tumor destroyed, was found to be dependent on the dose and was proportional to the size of the tumor at the time of treatment.

Destruction of the intramuscular lymphoma required a higher dose of roentgen irradiation than of radon (based on conversion to rep).

Irradiation of the whole body was essential to bring about tumor regression, even when the tumor alone was irradiated with more than three times the whole-body dose.

The systemic effect on tumor regression cannot be accounted for by any single organ, as shown by irradiating various parts of the body.

Seven graphs; 3 tables.

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Blood Coagulation and Hemorrhage Following Total Body X-Irradiation in the Rabbit. Robert L. Rosenthal and Agnes L. Benedek. Am. J. Physiol. **161**: 505–514 June 1950.

The present investigation was undertaken to explain further the mechanism of post-irradiation hemorrhage

and to determine whether or not a heparinemia occurs.

Adult rabbits, maintained on a standard laboratory diet, were given single doses (200 to 1,000 r) of total-body irradiation, with the following factors: 200 kv.; 1 mm. aluminum and 0.25 mm. copper filtration; target-skin distance about 14 inches; 40 to 50 r per minute, measured in air. Ten rabbits received 1,000 r; eight, 800 r; three, 400 r; one, 200 r.

The animals showed a blood coagulation impairment characterized by a thrombocytopenia, diminished clot retraction, increased clotting time of recalcified plasma, and increased anticoagulant effect of both added heparin and toluidine blue on the clotting time. These changes can be attributed chiefly to the diminished platelet count and function following x-irradiation.

No free or excess heparin was demonstrated in the blood following irradiation, as evidenced by the lack of significant prolongation of the blood-clotting time and negative toluidine-blue titration test. The rabbit, in contrast to man, dog and guinea-pig, shows an inconspicuous hemorrhagic response following x-ray exposure. The consideration of species differences in the clotting and hemostatic mechanisms and their response to x-irradiation is of importance in understanding and developing treatment of post-irradiation hemorrhage and applying the results of animal experiments to man.

Three illustrations; 2 tables.

Sensitivity of Abdomen of Rat to X-Irradiation. V. P. Bond, M. N. Swift, A. C. Allen, and M. C. Fishler. Am. J. Physiol. **161:** 323–330, May 1950.

It has been shown by various investigators that the abdomen of an animal is the most radiosensitive portion of the body, if morbidity and mortality following exposure to penetrating external radiation are used as criteria. Clinical observations in patients subjected to radiation therapy have confirmed these findings. Previous studies concerned with abdominal radiosensitivity have, however, been only qualitative in nature. As a first step in the further elucidation of the phenomenon, a quantitative statement as to the relative radiosensitivity of the abdomen as a whole is clearly necessary. A preliminary study (100 rats), employing partial body shielding, indicated that the abdomen is about twice as sensitive as the remainder of the body on the basis of animal mortality. The present experiment was performed in an effort to quantitate further the sensitivity of the abdomen under controlled conditions.

Approximately 200 male rats, weighing 250 to 300 gm., were divided into 10 groups. Five of these groups were exposed, with the abdomen shielded, to 1,600, 1,800, 1,900, 2,000, and 2,200 r, respectively; and 5 with only the abdomen exposed were given 700, 900, 1,000, 1,100, and 1,300 r. A Picker industrial x-ray machine was used. The radiation factors were 250 kv.p.; 15 ma.; filter, 0.6 mm., copper; h.v.l., 1.3 mm. copper; target-skin distance, 20 inches; output 47 r per minute. All doses were measured in air with a Victoreen 100-r thimble chamber.

The rats were observed daily over a period of twenty-eight days after irradiation, for clinical symptoms and mortality. A group of 15 normal unirradiated rats, handled in the same manner and for the same length of time, served as controls. Analysis of the mortality data indicates an LD 50 of approximately 1,950 r measured in air for rats with the abdomen shielded, and 1,025 r for those receiving only abdominal exposure. The LD 50 for total body x-irradiation is between 650 to 750 r for rats in the authors' laboratory (Biologic Division, Naval Radiological Defense Laboratory, San Francisco Naval Shipyard). In gram-roentgens, these LD 50 values correspond approximately to the following (for a 250-gm. rat): abdomen shielded, 275,000 gram-roentgens; abdomen exposed, 134,000 gram-roentgens; whole body, 175,000 gram-roentgens. The average survival times for the animals at each of several dose levels varied from 9.2 to 11.7 days and from 4.6 to 7.1 days in the two groups, respectively, showing no correlation with dosage in either case. The peak of deaths in the abdomen-exposed group occurred on the fourth and fifth days; that of the abdomen-shielded group, from the ninth to twelfth day after exposure. No deaths occurred among the control rats.

The abdomen-shielded animals appeared healthy until the sixth or seventh day, at which time they began to exhibit signs of illness: lethargy, ruffled fur, hunched posture, and progressive emaciation. Marked salivation appeared, characterized by copious pink-tinged fluid on the lower jaw. At no time did diarrhea develop, although some evidence of rectal hemorrhage was seen in a few of the rats *in extremis*. The abdomen-exposed rats became ill on the third or fourth day after irradiation. Diarrhea and hemorrhage were prominent, and no excessive salivation was observed.

A generally greater weight loss sustained in the abdomen-shielded rats suggests different metabolic patterns referable to the portion of the body irradiated.

Since the dose in gram-roentgens at any given exposure level was equal under both conditions of shielding, it is clear that the observed differences in radiosensitivity and in the resulting syndrome are a function of the region irradiated rather than of the total energy received. These differences in mortality, survival time, weight change, and clinical signs indicate two distinct mechanisms of death. Particularly striking was the finding that survival time is independent of dose in both shielded groups. The syndrome observed in the abdomen-exposed rats seems to correspond clinically to that usually seen following whole-body irradiation, while the symptomatology in the abdomen-shielded rats showed more similarity to that reported by Shouse and co-workers (J. Exper. Med. **53:** 421, 1931) in dogs following irradiation with abdominal shielding.

Three graphs; 2 tables.

Inhibition of Plant Growth by Irradiation. V. Radiation Effects on Initiation and Completion of Growth. Henry Quastler and Marianne Baer. Cancer Research **10:** 604–612, October 1950.

The observations reported concern linear growth in Mung beans after resection of various parts and after total or partial irradiation with various doses. The growth capacity is analyzed into two components: (1) the capacity to initiate growth, which is located in the top 2 mm., is dependent on food stored in cotyledons, and is determined by the age of the seedling; (2) the capacity to complete growth, which is spread along a zone of about 15-mm. length, is locally autarkic, and is determined by the position of the segment observed.

Irradiation with x-rays causes three distinct effects: temporary inhibition of growth completion and permanent reduction of the capacities of both initiating and completing growth. Permanent stunting is an effect of local irradiation.

An analysis of dose-response relations shows that the apparatus for growth initiation is more vulnerable than the apparatus concerned with actual growth.

Seven illustrations.

Fluorescence of Solutions Bombarded with High Energy Radiation (Energy Transport in Liquids). H. Kallmann and M. Furst. Physical Rev. **79:** 857–870, Sept. 1, 1950.

Pure liquids bombarded by high-energy radiation fluoresce but slightly. A small percentage of dissolved fluorescent substance fluoresces about 100 times as strongly as the same quantity in the solid state. Some dissolved substances quench fluorescence. Evidently energy absorbed by the solvent is transferred to the molecules of solute. Such a transfer of energy from the molecules absorbing it to other molecules nearby might be important in the biological effects of radiation.

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